

1 CHAPTER

SELECTION PROCESS EVALUATION

PURPOSE OF REPORT

This chapter of the report presents information about UDOT's selection process used to procure a design/build contractor to work on this project. This chapter supplements information contained in the first annual report, "*Design/Build Contracting Initial Report*", published by UDOT in October 1997. UDOT decided to use a "best value" selection process rather than "low cost" to select a contractor for this project, this chapter describes that process in detail along with other background information.

BACKGROUND

I-15 in the Salt Lake Valley was essentially completed in the early 1960's. By 1980, considerable congestion had begun to result in significant operational problems. In addition, 30-years of increasing traffic loads and the use of de-icing salts had resulted in severe deterioration of most of the bridges and elevated structures. Additionally, none of the existing structures had been designed to meet current seismic design standards.

To meet increasing traffic demands, the Wasatch Front Regional Council (WFRC), the Metropolitan Planning Organization, and Utah Transit Authority (UTA) were concurrently considering options to expand transit service within the Salt Lake Valley. Consequently, the decision was made to prepare a joint highway and transit needs and environmental study of the corridor. This resulted in the determination that I-15 needed to be reconstructed and additional capacity added to keep pace with the considerable growth occurring in the Salt Lake Valley specifically. Part of this reconstruction decision was to develop a fixed rail transit system (Light Rail) to serve the corridor.

UDOT began developing a program to expand and upgrade I-15 about 1990. The consulting firm of Parsons, Brinkerhoff, Quade and Douglas (PBQ&D) was hired to begin development and planning of a traditional design-bid-build project to replace approximately 26 km (17 miles) of urban interstate highway, including some 130 structures, eight urban interchanges and three major freeway to freeway junctions (I-15 connections with I-80 and I-215). Funding of the construction was a limiting factor that necessitated dividing the project into 20 segments to be constructed in phases, depending upon available funding, over an eight to ten year period.

The results of the December 1995, Governor's Growth Summit and UDOT public opinion surveys, focused attention on the I-15 corridor and the need to complete the reconstruction in a more timely manner. Six months earlier, Salt Lake City had been awarded the 2002 Winter Olympic Games. After an investigation of possible alternatives to expedite the construction of the project, UDOT decided in January 1996, to use Design/Build as the contracting method to complete the reconstruction. Consequently, the Utah State Legislature established the Centennial Highway Fund in February 1996 to address the unfunded transportation needs across the state with the I-15 reconstruction project as the centerpiece of that plan. A major objective was to complete the I-15 reconstruction in a shorter time period to reduce travel impacts prior to the beginning of the Olympic games.

SELECTION SCHEDULE

In February, 1996, UDOT contracted with PBQ&D to assist them in developing a request for proposal (RFP) for procuring the services of a Design/Build entity to complete the reconstruction project. Concurrent with the RFP development UDOT awarded several contracts to consulting engineering firms to prepare portions of a preliminary design of the project for use in the RFP. Part of this work included conducting an extensive geotechnical investigation of the corridor to provide foundation information that would be included in the RFP. Plans were developed by UDOT staff for suitable detour routes using existing parallel streets and expanding their capacity by adding additional lanes, improving intersections and traffic signals and other improvements.

In March 1996, a request for a letter of interest (LOI) was advertised internationally to identify potential entities interested in proposing on the project. Information meetings were held in May 1996, to brief interested firms on the project scope. On May 30, 1996, a formal request for statements of qualifications (SOQ) was issued providing information concerning the project scope, and instructions to potential bidders on the content and format of the SOQ and the criteria to be used by UDOT in evaluating the submittals. The submittals were due July 1, 1996, with expectations that as many as five groups would respond to the request.

This process was used by UDOT to screen potential firms with the intent to limit the number of potential bidders to no more than five firms. A qualification evaluation board was established to evaluate the submittals and determine which were qualified to propose on the project. Three SOQ's were received and each was judged qualified to proceed to the proposal stage.

On August 1, 1996, UDOT issued a draft Request for Proposal (RFP) to each of the three prequalified firms, requesting each to review the draft RFP and respond to UDOT with any comments, concerns or suggestions. UDOT also held individual face to face discussions with each group. UDOT modified the RFP and issued it in final form on October 1, 1996. Proposals were due January 15, 1997. Additional intermediate dates were established for:

- Submission of comments or requests for clarifications of the RFP
- Submission of technical concepts and requests for exceptions and deviations from the RFP
- Submission of an Air Quality Emission Control Plan
- Target dates for addenda to the RFP initiated by UDOT.

The RFP contained provisions for a Best and Final Offer (BAFO) process that UDOT could invoke, at their option (which was subsequently done). BAFO's were submitted to UDOT on March 7, 1997.

An award of the contract was announced on March 26, 1997, to a consortium of firms named Wasatch Constructors, led by Kiewit Pacific, Granite Construction and Washington Construction. The team also included a number of engineering design firms lead by Sverdrup Civil and De Leuw, Cather and Company. The award was made on the basis of "best value" determination and Wasatch was judged to have an "Exceptional" technical evaluation. The amount of the awarded contract was \$1.325 billion, which included the base bid and several construction options.

COMPARISON OF THE DESIGN/BUILD PROCESS TO TRADITIONAL CONTRACT

Traditional Contracting Approach

Public agencies have predominantly relied on competitive bidding to award highway construction contracts. This process involves preparing detailed plans, specifications and estimates for the work involved, a solicitation of bids through public advertisement and award of the contract to the lowest responsible responsive bidder. Authority to construct the project is obtained by the agency from appropriate public entities prior to bid advertisement. This may involve permits from environmental agencies and water management authorities, agreements with railroad and utility companies and maintenance agreements with local jurisdictions. All necessary right-of-way and construction easements are determined and acquired prior to contract advertisement.

The basic intent of this approach is to minimize risk to the contractor by defining all requirements of the project and eliminating most unknown conditions. Any errors and omissions in the plans or unforeseen work is the responsibility of the agency. Quality is assured through prescriptive plans and specifications coupled with construction oversight and inspection by the public agency. Cost is controlled by competitive bidding among contractors who have been prequalified by the agency to perform the work.

The Design/Build Process

With this contracting method the design and construction are combined in one contract which is awarded to a single design/build team. Construction permits and approvals, as well as railroad and utility agreements may be the responsibility of the team. However, because of legal issues and the unique expertise involved, right-of-way acquisition is usually handled by the agency. The team may be responsible for construction inspection with independent assurance by the agency or inspection may be performed by the agency in the traditional manner.

The decision to use a design/build approach is usually schedule driven. By combining the design and construction in one procurement significant time savings can be realized. Procurement of materials and actual construction may begin prior to completion of plans and specifications. Equally important, by combining the expertise of the designer and builder more efficient design, construction sequencing and maintenance of traffic schemes may be achieved thereby reducing contract time and improving performance of the facility during and after construction. Additionally, having design and construction responsibilities under “one roof” can result in time reductions in the design process. Contract duration may be specified by the agency but usually it is left to the design/build team and considered as one of the criterion in selecting the best proposal.

The UDOT “best value” selection process involved a qualitative evaluation of proposals from prequalified teams. Rankings for schedule, quality and cost were developed based on predetermined criteria. Technical rankings were then combined with the proposed cost to determine the best value and recommend award of the contract.

A more common approach involves competitive ranking of interested teams based on technical qualifications and past experience. A “shortlist” of design/build teams then bid for the contract with

award made to the lowest responsible bidder. This approach reduces the influence of qualitative rankings in the ultimate selection but tends to minimize innovation by the teams.

The design/build approach shifts a larger portion of risk from the owner to the contract team by requiring plans, specifications and estimates to be the responsibility of the contractor. Plan errors and omissions and unforeseen work are the design/build team's responsibility. This aspect of the design/build process is significant in reducing contract disputes, claims and cost increases during construction. However, because the contractor assumes more risk the price may be increased accordingly. The cost of increased risk may be offset by innovative design, early procurement of materials and overlapping the design and construction phases. Since most design/build procurements are, in effect, lump sum contracts the agency has greater confidence in cost containment. Financial planning for major contracts using the design/build method is therefore more predictable than traditional contracting methods.

In summary the design/build process has a number of distinct advantages over the traditional design-bid-build process.

- *Single entity responsible for design, construction and inspection.* Communication and coordination are more effective; reducing conflicts and resolving disputes quicker.
- *Reduced risk to agency.* Clarification and/or correction of plans in the field is the responsibility of the contract team. Overruns, change orders and supplemental agreements are virtually eliminated. Risk can be shifted more or less to the design/build team, depending on agency philosophy and nature of the project.
- *Significant timesavings.* Construction begins during plans development. The team designs the project based on contractor's strengths (labor, equipment, and expertise).
- *Firm cost of project.* Lump sum contracting and transfer of risk to the contractor enable the agency to better predict costs. Improved reliability of cost estimate greatly improves financial management.
- *Improved quality.* Teaming allows for greater innovation and creativity. Constructibility and maintenance of traffic are often significantly improved. More responsibility for construction quality is shifted to the contractor. Life cycle cost provisions, warranties and long term maintenance may be included in the contract to increase quality.
- *Outsourcing/Privatization.* Allows greater utilization of the private sector in design and construction management. This is more efficient than staffing up for a single major construction project or program.

UDOT opted to use the design/build process for the significant timesaving potential and the potential to reduce driver inconvenience with a shorter length construction period. Their desire to complete the project prior to the 2002 Olympics was also a contributing factor. Another significant factor was the ability to define costs early. Funding for the project was not completely secured beforehand and having a firm price for the work enabled UDOT to complete development of the funding plan for the project.

SELECTION PROCESS

Value Based Selection Process

UDOT was concerned about making an award based solely on low bid for this project, since detailed plans would not be available for use by the proposers. UDOT further wanted to permit proposers to submit innovative ideas for use in both the design and construction while being able to award the contract

to the firm(s) who made the proposal considered to be of “best” value to the State. This allowed consideration of innovative materials, processes or designs to determine whether these provided more value than alternatives proposed by other teams.

To meet these goals, UDOT developed a process they termed “best value selection” to select a firm for this project. A criterion was established for use in proposal evaluation. UDOT separated the evaluation of the technical aspects from the cost aspects to minimize the subjectivity of the evaluation. Only a small, select group of individuals were aware of both the cost and technical evaluation results and this group made the final selection of the contractor.

To enable UDOT to award on a design/build and “best value” basis special legislative authorization was enacted. The rules written for the authorization permitted UDOT to award on any one of the following conditions:

- Award to the responsible proposer offering the lowest priced responsive proposal. If the RFP includes a mandatory technical level, no proposal shall be considered responsive unless it meets that level.
- Award to the responsible proposer whose proposal is evaluated as providing the best value to UDOT.
- If the RFP provides for a stipulated sum, award to the responsible proposer whose proposal is evaluated as providing the best value to UDOT.

REVIEW PROCESS

UDOT wanted to make a selection based upon “best value” and not just the lowest price or capital cost. The evaluation was intended to weigh cost and technical competence equally. To accomplish this in the most impartial manner it was decided to evaluate each of the two aspects independently. To further enhance the process the evaluations of price were completed without disclosing the identity of the entity making the proposal, or a “blind” review.

This was accomplished by establishing strict controls over document distribution and confidentiality, and eliminating any reference to the firm or its members in the written price information. Separate and distinct review teams were used so they would not see both technical and price submittals. The review of teams was limited to specific areas, and a detailed procedure was developed to evaluate the submittals. UDOT developed a set of guidelines and held training sessions with each evaluation team to assure that they understood their role and the requirements of their individual reviews. UDOT established a contracts management group whose function was to monitor the process, coach the individual teams through the process, and secure the integrity of the process by safeguarding all of the proposal information.

The Technical Evaluation Board (TEB), composed of eight people, was responsible for the technical review. This board supervised the detailed review of the proposal conducted by several technical groups, each of which evaluated specific technical areas of the proposal. Four primary technical areas were established, listed in descending order of importance:

- Technical Solutions
- Work Plan/Schedule
- Management
- Organizational Qualifications

The technical solutions were further divided into several sub-factor groups. The organizational charts (Figure 1) show each of the technical areas and the number of reviewers assigned to each. There were some duplications of team assignments with a total of sixty-one people assigned to the various technical review committees. (Figure 2 is a flow chart of the process used).

The technical reviewers assigned adjectival (rather than numerical) ratings in each area. The ratings were:

- Exceptional (E)
- Good (G)
- Acceptable (A)
- Susceptible to becoming acceptable (S)
- Unsatisfactory (U)

Reviewers could further distinguish rankings by adding a plus (+) or minus (-) to these grades for ranking. These grades were then weighted for the value or significance of the technical factor and a composite grade determined.

Simultaneously prices were evaluated by the Price Evaluation Team (PET). This team completed an evaluation of the prices submitted by proposers using forms furnished in the RFP by UDOT, which separated costs into specific areas for evaluation. The team checked the price submittals for accuracy, price realism, balance and reasonableness as compared to other bidder's prices, with pricing data available to the team and with the UDOT Independent Estimate.

Once a review was made of both the price and technical factors, UDOT had the option to award the contract on the basis of this review, or they could proceed to a "discussion" level of review and BAFO. At this stage the review team could ask oral or written questions of bidders to obtain additional information concerning their original submittals. The additional information was restricted to the following areas:

- Advising bidder of significant weakness or deficiency so that bidder could modify their proposal to meet the minimum standards
- Attempting to resolve uncertainties or obtain clarifications
- Resolving any suspected mistakes in the submittal
- Providing a reasonable opportunity for proposer to submit any price, technical or other revision. In this case, UDOT was only permitted to tell proposer their price was too high, too low and/or unrealistic.

Initial Proposal (I) —————



Source: UDOT I-15 Team

Evaluation and Selection Organization Chart

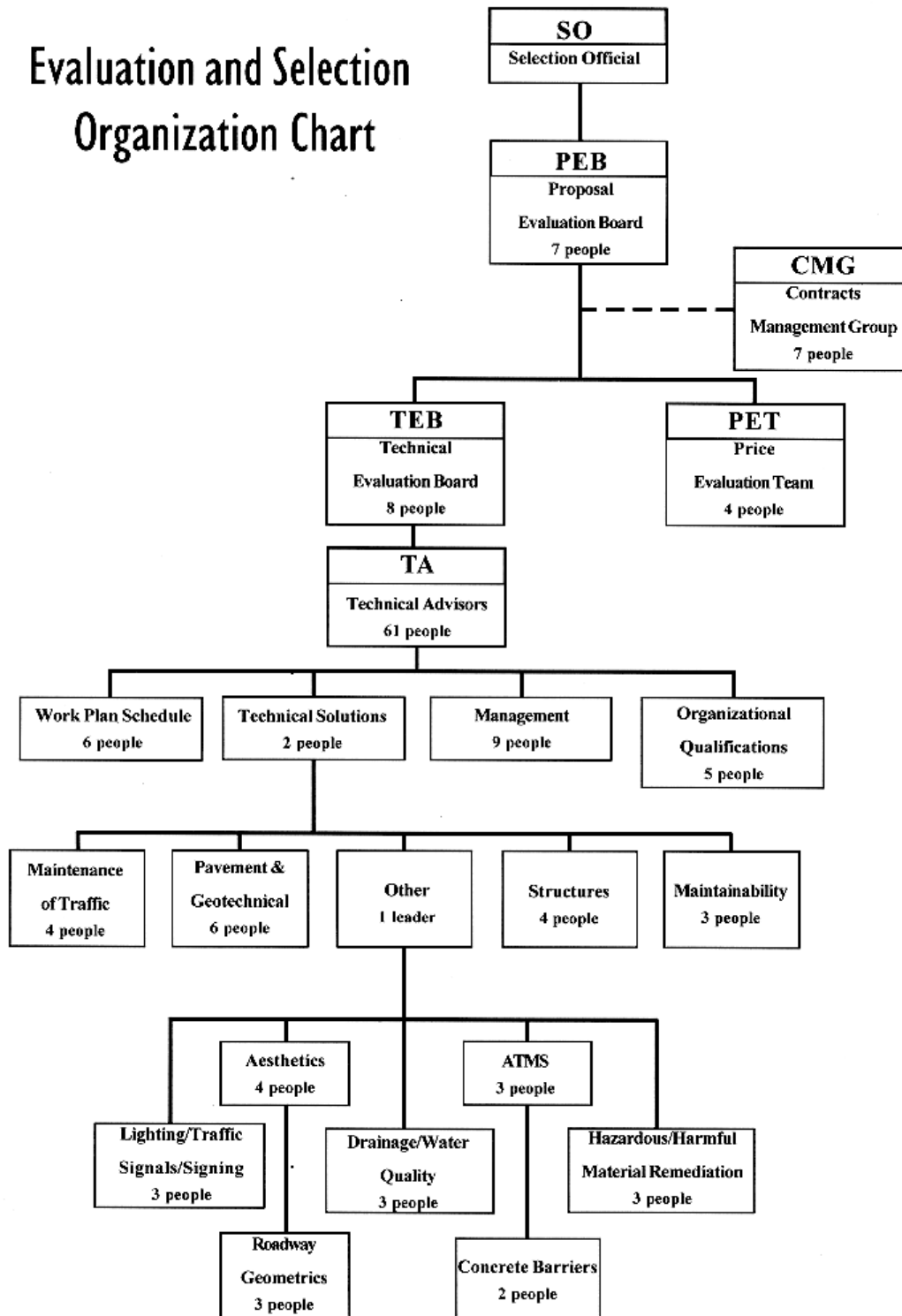


Figure 1-1

To ensure an atmosphere of fairness, if discussions were begun with one proposer, then discussions had to be held with each proposer. In lieu of oral discussion, written questions were submitted to each team for response. No indications were given on what the price should be or what other entities had proposed. During this process the review team was specifically prohibited from actions that could result in:

- *Technical leveling.* Making all technical proposals essentially equal
- *Technical transfusion.* Tipping-off proposers of other teams' ideas
- *Auctioning for better prices.* Trying to get proposers to reduce their price

Before initial proposals were submitted, UDOT held oral interviews with each design/build team. A two-hour time frame was allotted to each entity to make a formal presentation to the review team. This was followed by a recess where the review team formulated questions to ask the proposers. The interview was then reconvened and the questions were asked to the proposer.

UDOT could have awarded the contract after the initial evaluation but the option taken was to request a "Best and Final Offer" (BAFO). This process was similar to the initial evaluation process but the time permitted for proposers to revise their proposals was limited, as was the time for review. The process consisted of a short review to compare the revised submittal with the initial one and assign new ratings. The ratings were compiled by both PET and TEB and recommendations provided to the selection officer.

COMMITMENT REQUIRED TO PREPARE PROPOSALS

In preparing the RFP, UDOT quickly discovered that there were few performance specifications (specifications oriented toward outcome instead of means and methods) available for DOT type work and, therefore, decided to formulate their own. These specifications were developed by task groups covering areas such as pavement, structures, etc. The task groups consisted of UDOT employees, FHWA, personnel from the construction industry and engineering consultants. More than one hundred people were involved over a nine-month period in this developmental effort. The development was managed by a small UDOT Team who guided the efforts and provided the review. This team was composed of a diverse mixture of UDOT personnel with relatively young team leadership. The management team (six UDOT employees with consultants to advise) was assigned exclusively to the project. The team was also separated from UDOT's other operations by physically relocating them to offices located in the same building as their consultant.

USE OF STIPEND

Because of the significant resources necessary to propose on a project like the I-15 reconstruction, UDOT felt it appropriate to reimburse the unsuccessful proposers with a \$950,000 stipend. The intent of this payment was to: 1) ensure a maximum degree of innovation and quality in the development of the proposals, and 2) to allow UDOT to own and share with the successful proposer any innovative ideas contained in the unsuccessful proposals. Each of the three proposers spent \$3 to 5 million to develop their proposals. While the stipend apparently only covered approximately one-third of the development costs, UDOT believed it was a good faith indication of the agency's intent to proceed with the project, even though total funding had not been secured at the time the RFP was issued.

FHWA approved the use, but did not participate in the stipend. They felt it was a means of compensating teams for a portion of their proposal development costs as well as maintaining a competition that would contribute to design quality, innovation, and competitive price proposals.

OWNER PROVIDED INFORMATION

UDOT elected to provide the proposers what was termed as “30%” plans, which included alignment of the project and extensive geotechnical investigations conducted within the corridor. During preliminary development UDOT had several consulting firms develop segments of the project with emphasis on development of functional geometrics for the highway, typical bridge sheets for each structure and geotechnical investigations. One of the objectives of this level effort was to identify conflicts with utilities and railroads and determine what additional right-of-way would be needed for the project. UDOT committed to obtain all rights-of-way, permits and utility agreements for the contractor and therefore needed this information.

The question has been asked whether UDOT needed to provide this level of detail to get responsible bids for the work. Interviews with both the winning team and losing teams indicate that they could have prepared their proposals with less information. The level of information did appear to reduce potential risk by defining UDOT’s commitment, but much of the information provided about the roadway geometrics and structures was more than the contractors felt was needed.

Both Wasatch and UDOT have also expressed strong concerns about the use of completed plans (“sealed sets”) in the documents. UDOT actually completed final plans, signed and sealed by consultants, for portions of the work, the 600 North Interchange Structure being one example. Inclusion of complete documents for this interchange was thought important to accelerate the start of construction and while it has facilitated that, there have been several problems encountered as Wasatch sought to make changes in the plans to better suit their operations. UDOT has indicated that they would not provide completed plans for future design/build projects because of the problems experienced. The time saving is now viewed as less significant given the difficulties encountered with the changes.

All parties believed that the level of geotechnical information provided was a great value. It resulted in significant timesavings for the contractor because it was only necessary to supplement that information to complete the designs. UDOT estimated timesavings to the project was a minimum of one year.

RISK SHARING

One of the areas where UDOT made the greatest contribution to innovation was in the area of risk management. The agency went into the project with the philosophy that the entity with the best ability to deal with each area of risk should accept the specific risk. UDOT bought all of the rights of way, negotiated all the railroad agreements, negotiated all the necessary utility permits, and completed most of the exploration and drilling to collect information required to design foundations. This advanced effort gave the contractor the ability to immediately begin work after contract award.

Insurance

After many discussions with other agencies and firms that have dealt with large design-build projects, UDOT concluded that there was a potential savings if the state purchased and managed most of the insurance required for the project. UDOT has developed an owner controlled insurance program (OCIP) which is projected to save up to \$20 million dollars over the more traditional approach. The OCIP was purchased from an insurance specialist by UDOT under a separate procurement. The broker purchased and will manage most of the insurance policies and plans needed for the project. It covers worker’s compensation insurance and several types of liability insurance. The design-builder was required to

prepare a very extensive safety plan and obtain approval from the insurer early in the contract. To provide additional safety incentive, the design-builder will share in any reductions to the insurance premiums as a result of safe job performance.

Right-Of-Way

When the I-15 project was awarded, there were several right-of-way (ROW) parcels not yet acquired. To resolve this issue a ROW acquisition plan was included in the design-build contract. The ROW plan commits to having parcels acquired and available to the design-builder by certain dates so that operations will not be delayed.

Utility Coordination

For the I-15 project, UDOT formalized agreements with utilities and railroads to allow the design-builder to perform virtually all of the relocation work. This provided the design-builder much more control in meeting schedule goals and controlling the progress of work.

Subcontracting Requirements

Because of the obvious difficulty involved in tracking the amount of subcontracted work on a design-build project of this magnitude, the FHWA waived the provisions of 23 CFR 635.116, which required prime contractors to perform at least 30% of the work.

Changed Conditions Clause

UDOT was also permitted to modify the standardized changed conditions clause required under the provisions of 23 CFR 635.109, because many of these clauses, such as quantity overruns, are not applicable to design-build contracts. The changed conditions clauses written into the contract are reflective of UDOT's desire to assume a fair share of the contractor's risk and minimize the dollar value of risk contingencies included in the bid price.

Performance Bond

Typically, highway construction projects require performance and payment bonds that equal 100 percent of the contract bid price. Research by UDOT's I-15 Team indicated that it would be very difficult to find surety firms that were individually capable of, or willing to, underwrite performance and payment bonds in excess of \$250,000,000. After much discussion, it was concluded that the \$250 million bond would be adequate to protect the interests of the State and this was required in the RFP.

COST OF PROJECT

A good deal of confusion concerning the actual dollar amount of the construction contract for the project surfaced after contract award. The amount of the award to Wasatch Construction was \$1.325 billion, including the options presented in the proposal that were selected by UDOT. The long term maintenance options included in the bid have not yet been exercised so those costs are not included in the current contract amount. The overall program costs total \$1.59 billion when all of the UDOT incurred costs attributed to the project are included. The following table presents a summary of the costs included in the overall budget.

I-15 Design/Build Project – Cost Summary	
Item	Cost
Management of project (UDOT and Consultant Costs)	\$50,000,000
Right-of-way Acquisition	54,582,000
Parallel Street Reconstruction for Detours	41,100,000
Preliminary Engineering (Consultants)	4,687,000
ATMS Traffic Operations Center	5,624,000
Award Fee	50,000,000
Owner Controlled Insurance Program (OCIP)	20,000,000
Wetlands Remediation	400,000
Stipend to Unsuccessful Bidders	1,900,000
Drainage (Contribution to Shared Facilities)	2,274,000
Utilities	19,000,000
Railroads	9,210,000
Public Information Program	6,180,000
Subtotal Related Costs	\$264,957,000
Construction Contract – Base Bid plus Options	\$1,325,043,000
Total Project Costs	\$1,590,000,000

During the development of the RFP, UDOT estimated the project construction costs at approximately \$1.09 billion. This amount was based upon an estimate of construction made in early 1995, prior to considering using Design/Build.

UDOT engaged a construction firm (J. A. Jones) to prepare an estimate of the project assuming a design/build approach for use in evaluating the proposals. Because the scope of the project was being modified (up until the date the RFP was released to potential proposers), the Jones estimate was not completed and available to UDOT until after the RFP was released.

UDOT elected not to disclose the Jones estimate because they felt it was available too late in the process and could negatively influence the submittals from the contractors and later during the BAFO process. Therefore, they chose to keep that estimate confidential. The proposals received from the three firms were all within 3.5 percent of the estimate prepared by Jones (\$1,384,125,109).

In retrospect, UDOT has indicated that they should have been more aggressive in updating their budget estimates, revising them each time the scope of the project was modified. UDOT strongly recommends that updates be done on future projects and that the overall estimated costs be released prior to releasing the RFP to proposers, if possible.

The contract also allows Wasatch Construction to submit changes to the contract for consideration by UDOT. As of July, 1998, Wasatch has submitted fifteen changes that UDOT has accepted with the net result being no appreciable change in the overall construction cost. This process of allowing the contractor to submit proposed changes will be continued throughout the construction period. UDOT's stated objective is to consider any potential change that will provide a level of quality or service equal to or greater than that contained in the original contract.

PHILOSOPHICAL SHIFT REQUIRED TO IMPLEMENT DESIGN/BUILD IN PUBLIC AGENCIES

Going from a low bid environment to a best value contracting philosophy can be challenging for any agency. Tradition and well-established practices are not easily modified. Employees become comfortable with long established practices that have served them well so that even when consensus is reached to implement an innovative concept, institutional inertia must be overcome. Successful deployment of the design/build concept is certainly dependent on a shift in agency philosophy.

The traditional approach to contracting places the greatest risk and greatest control within the agency. The agency is responsible for the plans, specifications and estimate of quantities. Construction oversight to ensure quality is also handled by the agency. The contractor is solely responsible for constructing the project in strict compliance with the plans and specifications and within the bid amount. Design/build, on the other hand, transfers responsibility for the plans, specifications, estimates and construction management to an outside entity.

This shift in control and accountability is not readily accepted by all agency employees. Outsourcing design responsibilities may be difficult in an agency that has traditionally handled such work with in-house staff. Agency design personnel may not feel confident that consultant design firms have the expertise to perform at the same quality level. Allowing the contractor and designer to collaborate on the design may raise concerns that quality may be sacrificed for profit. The same is true with regards to construction inspection by a design/build partner. Concern that the “fox is guarding the hen house” is often an issue.

In order to achieve support and, hopefully, enthusiasm for design/build contracting it is essential that strong leadership and commitment among agency managers be present. The head of the agency must support and encourage the process since direct involvement by the agency head, while not mandatory, greatly enhances the pace of implementation. Inadequate support at the highest level will make implementation difficult, if not impossible. The agency must recognize the risks involved, accept them and provide the support necessary to carry out the effort. This may require establishing a task force or steering committee dedicated to the task. It is important that the team members involved be strong leaders, open minded to the change in philosophy and committed to seeing it through. Employees involved in the implementation must be allowed to focus on implementation.

As more agencies experiment with and adopt design/build contracting techniques the cultural changes required will be easier for others to achieve. Successful application of a new process by one's peers greatly reduces the apprehension and concerns about the process.

ISO 9000 CERTIFICATION

The contract requires that Wasatch have the overall responsibility for both Quality Control (QC) and Quality Assurance (QA). The contractor's on site Project Construction QA Manager is required to be an employee of an independent QA firm that is not otherwise associated with the construction work. The construction QA Manager reports directly to the Wasatch Principal and is independent of the Contractor's construction staff. The construction QA firm performs all of the construction inspection and sampling and testing work that is normally performed by UDOT. This includes the documentation of construction activities and acceptance of manufactured materials. UDOT's construction role is limited to oversight of the QA firm's activities, verification sampling and testing, independent assurance sampling and testing,

review of progress payments, and oversight of the contractor's construction management scheduling, document control, etc. UDOT is also responsible for project acceptance. They may use Contractor provided test and inspection reports to assist them in performing the project acceptance.

The contractor is also required to have a QC program but the actual design of that QC program is left up to the contractor. While there are strict certification requirements for the construction QA personnel, there are no comparable formal certification requirements for contractor QC personnel. The QC and QA programs can be integrated, if appropriate, but all acceptance inspection and testing must be performed solely by employees of the independent entity responsible for construction QA.

In order to improve the Quality Program all major participants in the contract are required to provide and participate in a quality program in conformance with ANCI/ASQC Q90001 (ISO 9000). This is an internationally recognized certification process used to assess the implementation of quality control processes throughout an organization. To comply with the contract requirements, all of the major participants of the contractor, including the independent firm responsible for construction QA, must be certified within twelve months following notice to proceed. While the certification by itself cannot guarantee a quality product, it does provide a documented process for integrating quality control with production activities and is consistent with UDOT's emphasis on a quality product.

This is a vast improvement over the process utilized on other recent Design/Build projects, where there was not a requirement for the certification. The requirement for ISO 9000 certification offers the potential for improved QC inspection and documentation, less rework, and less lost time and expense. The use of ISO 9000 can support the project goal of faster production and earlier completion, if monitored adequately.

AWARD FEE

UDOT included a financial incentive in the contract called an "Award Fee" was established with the following criteria:

- *Timely Performance*
- *Quality of Work*
- *Management*
- *Community Relations/Maintenance of Traffic*

The criteria were judged to represent the most critical elements of the project. UDOT believed that the award fee would provide an incentive to ensure performance at or above expectations and completion of the construction on or ahead of schedule. The amount of the total fee potentially available was established at \$50,000,000. The fee could be earned over the life of the contract in varying amounts. An incentive of \$5,000,000 was specifically targeted to be paid if the contractor is substantially completed with the entire project 90 days or more ahead of the stated target date of October 15, 2001.

Approximately one-half of the entire fee is based upon the Contractor meeting or exceeding Timely Performance goals. The balance of the fee is earned by a satisfactory evaluation of the Contractor's performance in the areas of Quality, Management and Community Relations/Maintenance of Traffic. The award fee amounts were pre-established for each six-month period of the contract and are payable at the end of each period. These amounts may be revised during the contract either by mutual agreement or

unilaterally by UDOT. UDOT paid \$2.49 million out of a possible \$2.5 million for the initial award period and recently approved the award of the entire \$5.0 million second award period.

Since the award of the contract, UDOT has redesigned the procedures for rating the contractor on performance to provide clarification and a more objective method of judging the Contractor's performance. The original procedures were adapted from the US Navy and UDOT has chosen to fine-tune it to make it easier to administer.

Even with the revisions, the award fee process is viewed by UDOT as highly subjective, difficult, cumbersome to administer and very time consuming. Three levels of review of performance are used to determine the fee with evaluations made by project engineer and management level staff on a monthly basis and then by upper management and the Executive Director of UDOT on a semi-annual basis. The final determination of the amount of award is made by the Executive Director.

There is concern that the amount of the Award Fee is causing problems in administering the project. It is UDOT's opinion that the size of the fee has caused both UDOT and Wasatch to focus too much attention on assuring that it is administered and paid appropriately. There is also concern that the amount of the fee has negatively influenced the partnering relationship between UDOT and Wasatch. Additionally, there has been some negative public reaction to the award fee thought primarily to be due to a lack of understanding by the public of the reasons for the fee. Finally, the award fee is viewed by some as such a large portion of Wasatch's profit on the project that they are focusing much of their attention on earning the entire award fee and probably not focusing enough attention on the other aspects of the project.

UDOT now believes that the incentive was not as necessary as originally thought and indicated that they probably would not include an award fee in future design/build efforts unless it were tied closely to tangible or quantitative deliverables such as milestones and less on subjective evaluation criteria.

DISTRIBUTION OF PROPOSAL INFORMATION

In preparing the RFP it became apparent that there would be more than 40,000 written pages of instructions and information as well as many thousands of drawings and pages of geotechnical reports provided to prospective proposers. UDOT wanted to provide copies of all this information to each proposer so that each had the same information on which to base their proposals.

UDOT elected to place all of this information on CD-ROM's and distribute these to each proposer. The information was indexed and four disks were required to contain the more than 70,000 pages of documents. A hard copy of the RFP information was available for examination at UDOT's office, but no hard copies were available for distribution. This was viewed by UDOT as potentially saving time for the agency and the proposer as well as reducing the expense of copying all of the information.

After interviewing the teams who proposed on the project it was apparent that this form of distribution was not efficient. It took several weeks for proposers to download, print and catalog all of the information resulting in approximately a three week delay for some proposers before all the necessary information was available to begin preparing their proposals. It was also difficult to organize the information and determine if there was anything missing. Most proposers had the advantage of having one or more of the engineering firms who had prepared a portion of the preliminary design on their teams but none of them had access to all of the information from other sources.

UDOT has since concluded that this attempt to disseminate the information was unsuccessful and plans to provide at least one printed copy of the information to potential bidders if they use CD-ROMS on future similar projects.

UDOT is continuing to distribute condensed versions of the CD-ROM information to interested agencies that want to have the bid document information. A version has been condensed into a single CD-ROM, which contains all contract information and the Wasatch proposal but does not contain the engineering drawings and geotechnical reports contained in the original RFP.

Conclusions of Selection Process

There have been a number of lessons learned from the process used in the selection.

- *Commitment Level of UDOT Staff.* The UDOT needs to assign personnel who are willing to learn and accept a new way of conducting business to embark on the first attempts at a Design/Build project. This is needed to develop an acceptance of new ideas and procedures and to reduce the tendency to want to return to the tried and true processes.
- *Use of Stipend.* A stipend should be considered if the effort to prepare the proposal is considered to be extraordinary or the DOT wishes to own the ideas developed by each team for possible use on the project. Also it should be considered if the DOT feels that there is a need to show good faith to contractors that the project will proceed.
- *Owner Provided Information.* Provide a level of design required to define the project and the risks considered to be significant. Match the information developed with the potential risks of the project. Avoid providing completed designs prepared by others if possible to avoid conflicts over changes made during construction.
- *Risk Sharing.* The sharing of risk is a critical element of the design build project. UDOT prepared a risk matrix before the project was developed to determine the types and amount of risk and which party was best able to deal with the risk. They then assigned the risks to the parties best suited to deal with them.
- *Cost Estimates of the Project.* UDOT found that it is important to provide complete public disclosure of cost estimates during the process of selection and award of the contract. This removes the potential for confusion about the process and its costs.
- *Award Fee.* While incentive awards can be important to a project's success, care needs to be taken to make the process as objective as possible to avoid conflicts in the award of the fee.
- *Distribution of Materials on CD-ROM.* Distribution of contract documents should include hard copies of all information. CD-ROM, or some other electronic method, can be used to provide access to additional copies or supplemental information not considered to be critical to proposal preparation.
- *Best Value Selection Method.* UDOT feels that the use of "best value" rather than low bid is critical to the success of this project.

- *Confidential Selection Process.* UDOT felt that maintaining absolute confidentiality during the proposal evaluation was essential to the success of the selection and award process. It resulted in acceptance of the selection process and assured fairness in the evaluation.

2 CHAPTER DESIGN PROCESS EVALUATION

OBJECTIVES OF EVALUATION

This section presents an initial assessment of the design process being used on the I-15 Design/Build project by Wasatch Constructors and it discusses the design review process used by UDOT. The report is prepared based upon a review of the Design Quality Management Plan (DQMP) developed by Wasatch Constructors for this project and interviews with both UDOT and Wasatch staff members involved in the design process. The organization used by Wasatch Constructors on the project is shown on Figures 2-1 and 2-2.

OVERVIEW OF DESIGN PROCESS

The project has been divided into three geographic segments for construction purposes with each segment being further divided into sections for development of the design. Overall there are four sections with five sections in segment 1, six sections in segment 2, three sections in segment 3 and a segment for the Automated Transportation Management System (ATMS) elements of the project. Each section will have a final design package prepared. Typically there are also several early action packages that are developed to accommodate the accelerated construction with packages generally developed for specific action items such as foundation, utilities, grading, etc. A complete package for each roadway section will consist of approximately 1,000 plan sheets plus specifications. The total number of plan sheets for the roadway construction is expected to exceed 12,000 sheets.

Reviews of all designs are performed at the 30%, 65%, 90% and 100% completion stages. These reviews are completed by Wasatch Constructor employees who have not been directly involved in the design. UDOT is also provided with copies of review sets for their comments. Additionally, Technical Coordination Reviews (TCR) and Discipline Coordination Review (DCR) meetings are conducted of each plan set with representatives of Wasatch Constructors, Sverdrup/DeLeuw (SDL) and UDOT invited to each review meeting. FHWA and others are invited to attend as well. Figures 2-3, 2-4 and 2-5 show the process used in the Roadway Design, Wall Design and Bridge Design elements of the projects. These figures, were provided by Sverdrup/DeLew and are part of the DQMP.

After each review is held checklists are prepared for each review comment with review comments typically falling into one of four categories.

- 1. *A = Agree***
- 2. *B = Justify***
- 3. *C = Ignore***
- 4. *D = Refer to Wasatch Constructors for constructability review***

These comments are then presented to the review team in the Comment Resolution Meetings (CRM) held for each review. A resolution of each comment is determined and direction provided to either accept or change the design.

Wasatch Constructors also performs constructability review which consider many factors including the availability of equipment and materials to construct the design.

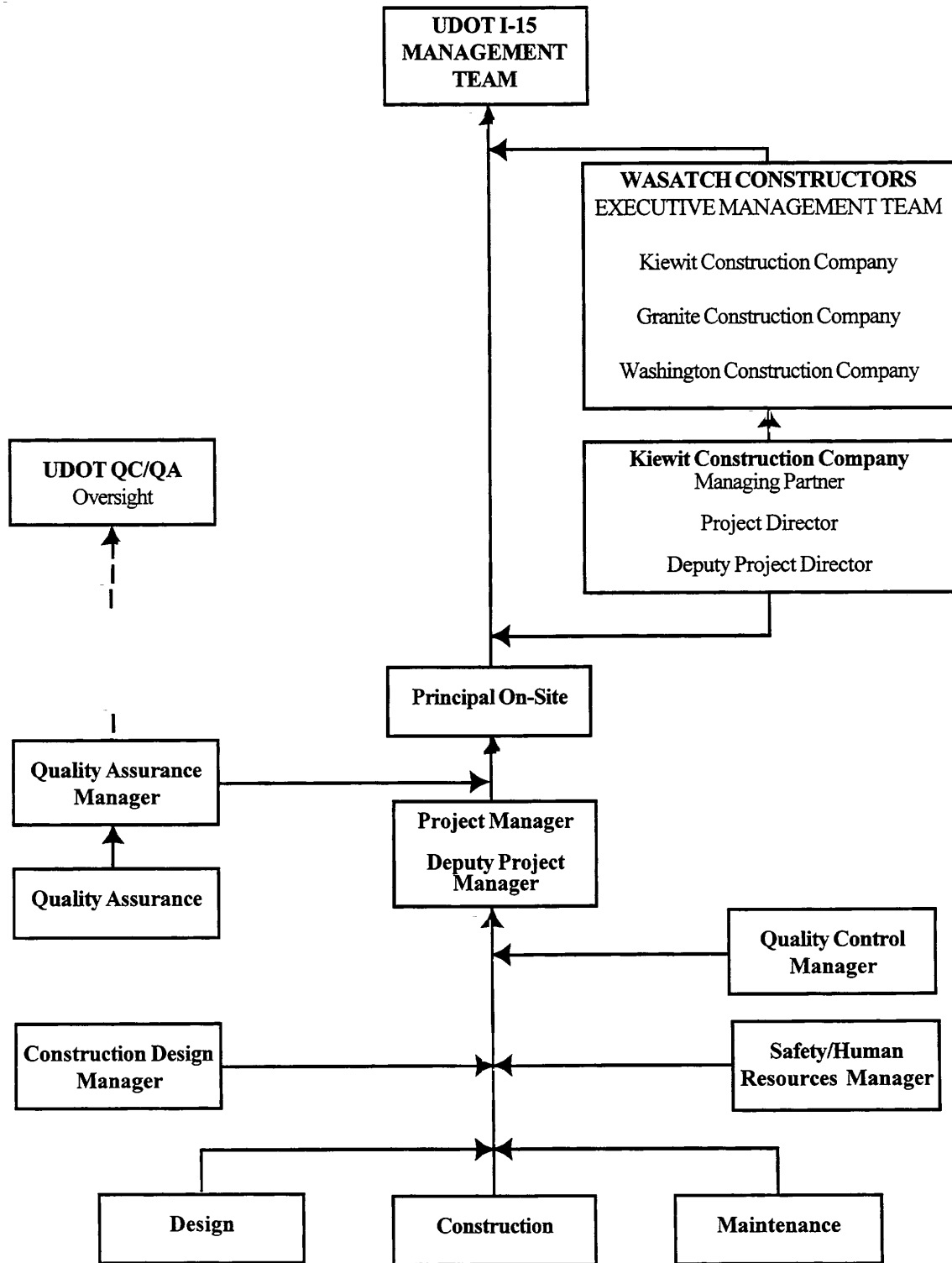


Figure 2-1

*I-15 Corridor Reconstruction Project
Special Experimental Project No. 14*

2-2

*1998 Annual Report
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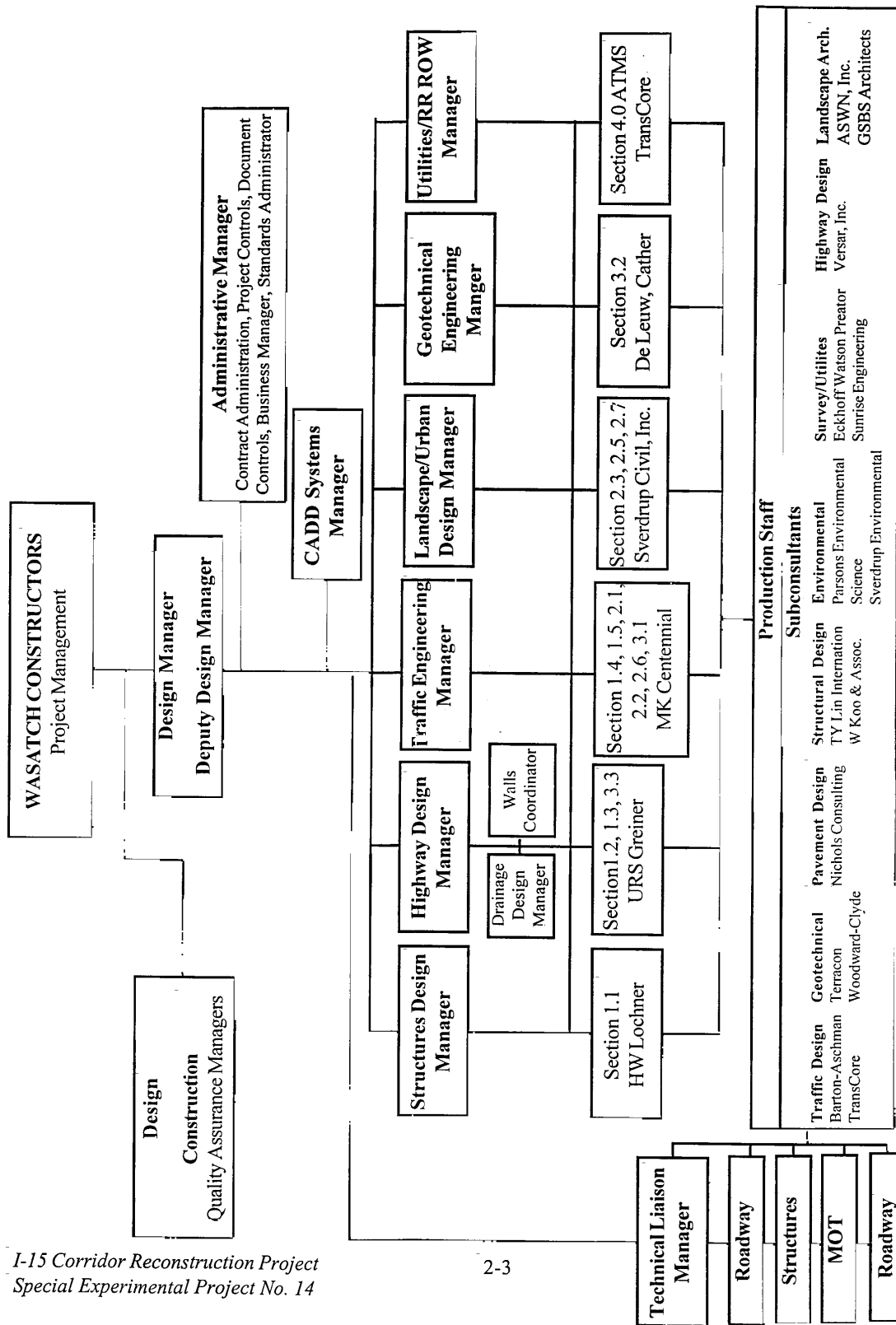


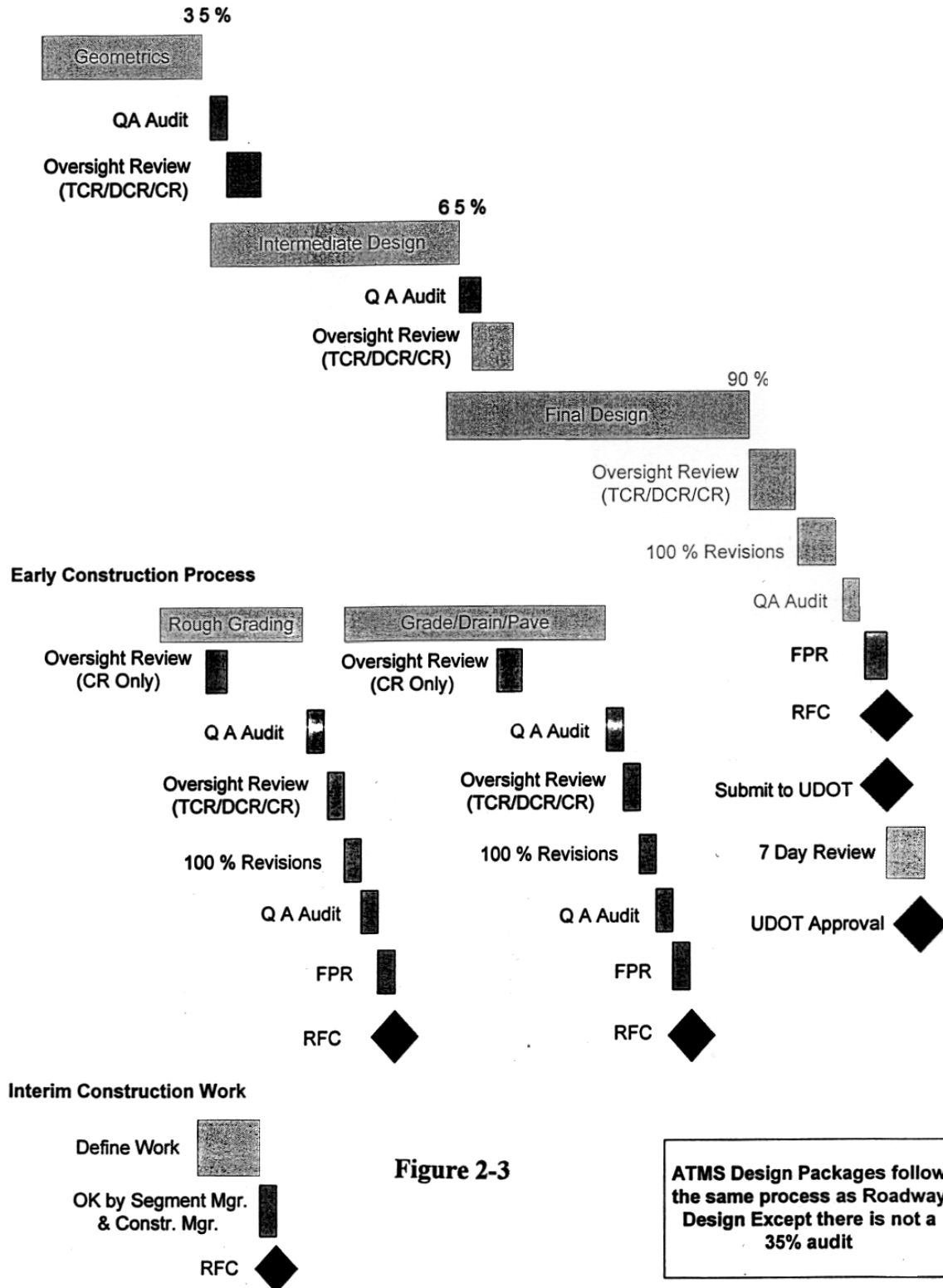
Figure 2-2
2-3

I-15 Corridor Reconstruction Project
Special Experimental Project No. 14

2-3

Full Design Process

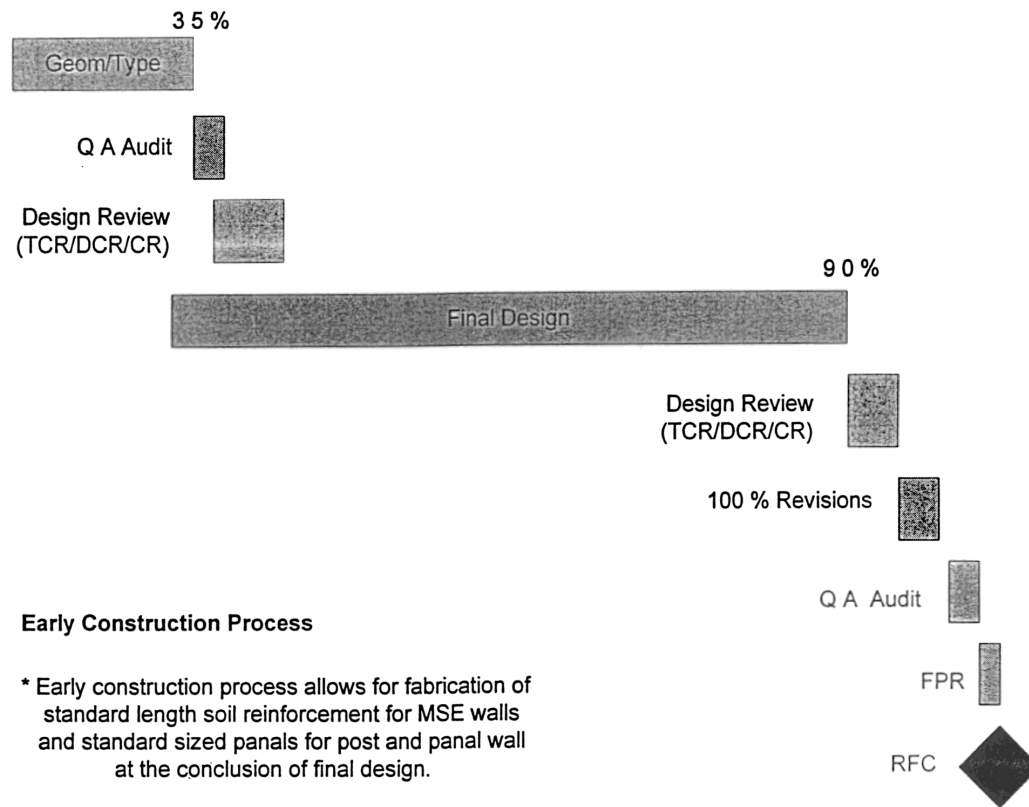
Sheet 1 of 3



2-4

Full Design Process

Sheet 2 of 3



Early Construction Process

* Early construction process allows for fabrication of standard length soil reinforcement for MSE walls and standard sized panels for post and panel wall at the conclusion of final design.

MAINTENANCE OF TRAFFIC DESIGN

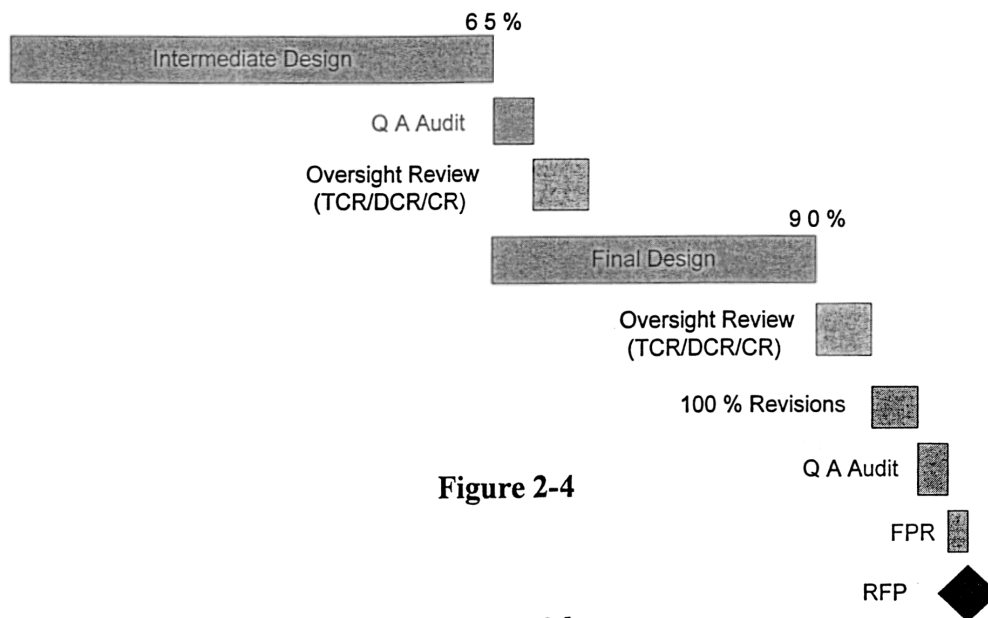


Figure 2-4

2-5

2-5

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BRIDGE DESIGN

Full Design Process

Sheet 3 of 3

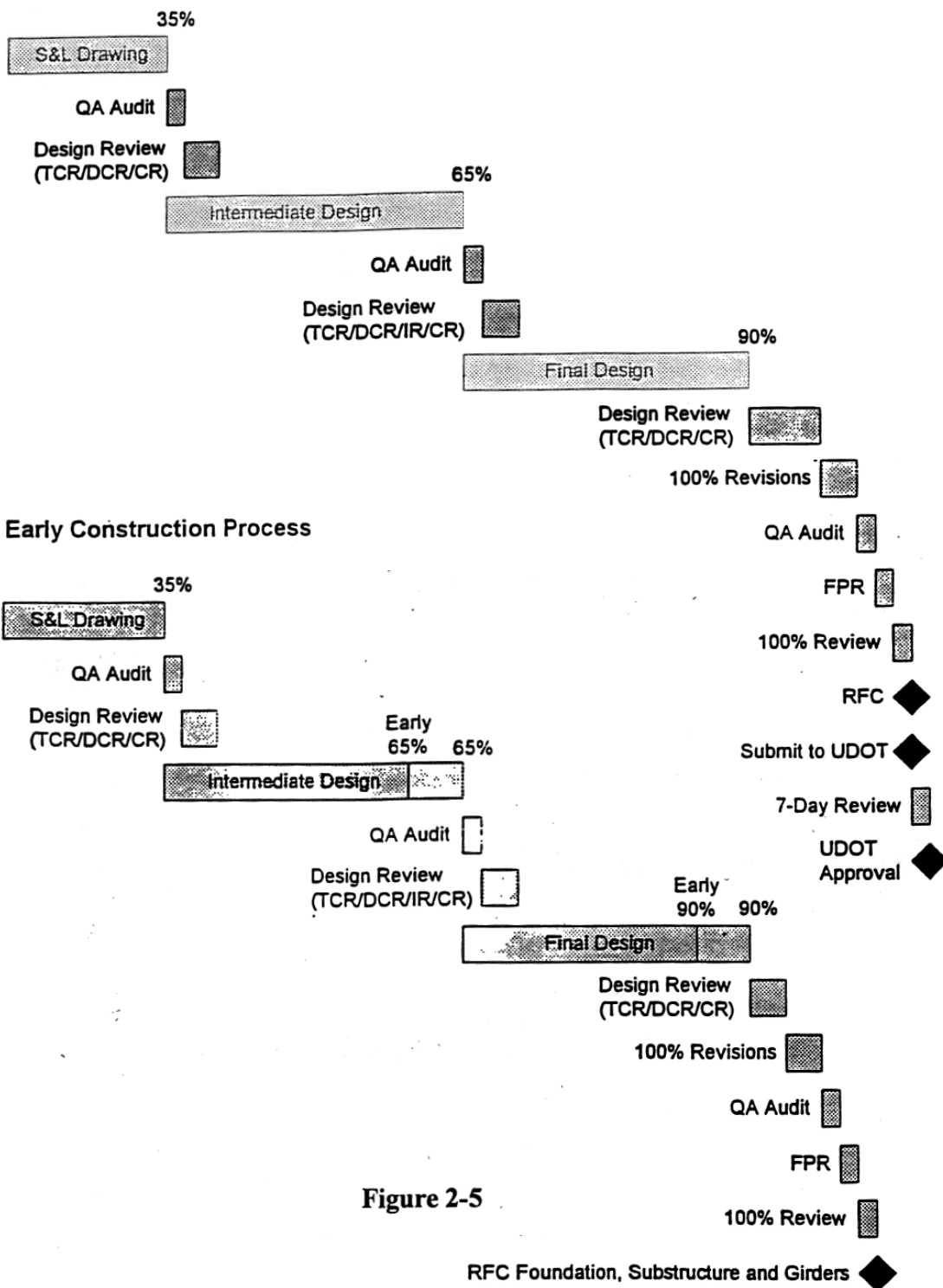


Figure 2-5

Quality Assurance reviews are conducted at each design review milestone. These reviews are made to ensure conformance to standards developed for the project as well as to assure that technical reviews have been completed. A final QA review of the 100% plans package is also made before submitting the plans to Wasatch for use in construction.

Implementation of the Design QC/QA Program

The entire design QC/QA process is included in Volume I of the "Design Quality Management Plan" (DQMP) of Wasatch Constructors' QC/QA Plan for the I-15 Corridor Reconstruction Project and was produced by the Wasatch Constructors' design consultant, Sverdrup/DeLeuw. The DQMP was prepared in conformance with the Interpretive Guidelines for the Application of ANSI/ISO/ASQC Q9001-1994 for Owner's, Designer's and Construction Quality Management Systems, April 1995, issued by the Design and Construction Division of the American Society for Quality Control.

The responsibility for the overall Quality Assurance/Quality Control QC/QA program resides with the contractor, Wasatch Constructors. The team of DeLeuw/Sverdrup was hired by Wasatch Constructors to perform the design for the project and at its peak mobilized up to 400 individuals including 19 subcontractors. Ninety percent of the design has been performed in the 'HUB' complex, the centralized office which also houses Wasatch and UDOT Staff. Final design submittals are scheduled to begin in December 1998 and extend through March 1999. UDOT's role is to audit the contractor's QC/QA processes on an oversight basis, but not to approve specific design elements. UDOT monitors compliance with the internal QC/QA program. UDOT has the ability to withhold or reduce performance awards if established procedures are not being properly implemented.

The DeLeuw/Sverdrup design team has developed the QC process for the project and each member of the design team has received training in that process. For the design process, Wasatch Constructors has a full-time Quality Assurance (QA) Manager who is responsible for reviewing each plan submittal at the 30%, 65%, 90% and 100% completion stage. Every plan submittal has an established formal checking process and must be formally reviewed and approved by the QA Manager before it is released for construction. The QA Manager also performs internal performance audits every six months. To date, the QA Manager has released approximately 1,200 design packages.

Structure design for the 142 bridge projects has a more rigorous design process that incorporates independent design reviews performed at the 80% completion level. The independent reviewers are required to be registered professional engineers and have experience in the type of structure being checked. Each structure is tracked separately from a scheduling standpoint and each release goes through the Structures Design Manager prior to being submitted to the QA Manager. Also of interest, each structure goes through a review for compliance with seismic standards and specifications as part of the process.

Several processes have been introduced on the project to enhance and ensure success of the QC/QA program. Task Force meetings, which include staff from Wasatch, DeLeuw/Sverdrup and UDOT, are held weekly to coordinate critical issues and track progress on key discipline areas (e.g. roadway design, structures, geotechnical, method of handling traffic, ATMS). Notes are taken at every Task Force meeting and distributed to document decisions and resolutions of key issues. If issues cannot be resolved at these Task Force meetings an escalation mechanism has been established that convenes a Dispute

Review Board composed of representatives chosen at the inception of the project by each of the three parties; UDOT, Wasatch and Sverdrup/DeLeuw. UDOT also performs concurrent “over-the-shoulder” reviews to provide continuous input into the design process. A document control system is strongly followed to manage all of the documentation the project has produced.

SCHEDULING:

The construction schedule established by Wasatch Constructors is the driving force for the design schedule. Project completion established by contract is October 2001, with the Winter Olympics in early 2002 as the trigger. Wasatch Constructors established a July 2001 completion date and every effort is being made to accomplish that goal.

As construction milestones are established those dates are communicated to the DeLeuw/Sverdrup design team and Ready for Construction plan releases are provided to meet those milestones. For example, some of the 142 bridges were determined to be on the early-action critical path and subsequently identified for early design completion.

Effective communication between the partners is a must for meeting schedules and deadlines. The decision to house all the partners in one central location, the ‘HUB’, has played a major role in meeting schedules for design completion. Weekly Task Force meetings leading to prompt resolution of conflicts have also contributed to the success thus far of meeting aggressive design schedules.

Additional evaluations are recommended to expand on the scheduling aspects of the project.

‘OVER-THE-SHOULDER’ REVIEW

The responsibility of the correctness of the plans is placed directly with the Designer rather than having detailed checks by the Agency. UDOT performs an ‘over-the-shoulder’ review consisting of reviewing the project concurrently with its design and development. This provides immediate reaction and input from all parties. Final design submittals, scheduled for the end of 1998, will ensure that all comments and issues have been addressed, plans are complete, and that Quality Control checks have been completed. Each of the fifteen section final design packages will then undergo separate seven-day reviews. The ‘over-the-shoulder’ review emphasizes concurrence with the design as it is being developed and periodic audits performed by UDOT ensure the design is basically sound.

From an over the shoulder review standpoint, the tracking and documentation of field changes have been formidable tasks. Field changes are classified as minor (reviewed and approved in the field by the Resident Engineer) and major (reviewed and approved by personnel in the ‘HUB’ similar to the established design process). Since there are, by necessity, so many field changes in a project of this magnitude, UDOT staff indicated that they would be more comfortable with the field change process if:

- a more responsive system of disseminating information was developed to handle corridor issues occurring on more than one of the several sections
- further development of project standards could be undertaken to reduce redundant reviews
- UDOT/FHWA construction check-offs could be included as part of the technical agreements used as formal project documentation

- ‘core’ personnel involved in the conceptual design could be retained and used to review current work products.

Understandably, UDOT personnel are concerned that inadequate in-house staffing and the press of time to review field changes put additional stress on the effectiveness of the ‘over the shoulder’ review process. They agree however, that it is beneficial to have the designer more accountable for the final product, and that this has resulted in immediate design/constructability feedback and a better overall plans package.

APPROVAL AUTHORITY

The design/build process is intended to expedite the design process and permit construction to begin prior to fully completing construction plans. Many design documents are being released in phases to expedite the construction process. An example is a bridge structure where foundation plans are released for construction prior to completion of the superstructure design. Subsequently, separate plans for piers, pier caps, girders, and finally deck details are released. As the design progresses, updated plans are released showing the previously completed and added design details. There have been instances where up to ten releases have been made on the same construction element. Items, which are not intended for construction, are clearly marked on the drawings using hatching, clouding or other techniques and as designs are advanced, these marked areas are removed. Field changes made in prior phases are also shown in the revised plans.

Because of this accelerated process it becomes essential to control approval of documents released for construction. To control the process Wasatch Constructors has established procedures to control the process of drawing approval. These procedures are documented in the Design Quality Management Plan (DQMP) developed by Wasatch Constructors specifically for this project. All drawings or specifications used for the construction are prepared under the direction of a licensed professional engineer with the engineer-of-record signing and sealing the design plans prior to submitting them to the Section Design Manager who is responsible for approving the documents for release.

The design team conducts reviews at 30%, 65%, 90% and 100 percent stages of completion with two types of reviews conducted at each stage of the design development: Technical Coordination Reviews (TCR) and Discipline Coordination Reviews (DCR). These reviews are conducted in a formal meeting setting with representation from the designers, contractor and UDOT. FHWA and specialists such as steel girder construction staff are often invited to attend. For bridge structures, senior level engineers concentrating on critical or highly stressed areas of the bridges conduct independent reviews.

Wasatch Constructors also conducts a constructability review and examines the following areas:

- Consistency with design concepts
- Adequacy of information to construct the work
- Availability of materials, equipment and labor to construct design
- Survey control verification
- Consistency with environmental mitigation requirements
- Maintainability
- Ability to construct the work
- Proper incorporation of review comments

Once reviews are conducted and changes made to the documents, the designer places his/her seal on the document and submits it to the Section Design Manager. The Section Design Manager forwards the documents to UDOT, Wasatch Constructors and the QC/QA staff for an additional review. An audit of the QC process is conducted and the Design Quality Assurance Manager signs the documents and returns them to the Design Manager. Once the Design Manager is satisfied that the documents are complete and that Wasatch has completed a constructability review, he/she signs the plans and releases them to Wasatch Constructors. This approval is called an 'Approve For Construction' (AFC). The Wasatch Construction Manager will then 'Release For Construction' (RFC) the documents to the Construction Section Manager for use in the field.

DESIGN CHANGES

Design changes are covered by Section 4.9 of the DQMP and detailed design change processes are covered in Section 2.2, Quality System, under Design Quality Procedure (DQP) 3.11 (Changes prior to construction) and 3.12 (Changes initiated after construction begins). These procedures include detailed responsibilities and documentation requirements, including timeframes for review and approval. Based on the level of detail and the numerous review processes incorporated in the normal flow of contract documents during design, it is clear that the design changes are receiving the appropriate level of scrutiny.

There are two types of design changes defined. Minor changes include any change to the I-15 project that does not conflict with the intended use, structural stability, or safety of the project. Major changes are those having such a potential impact requiring input from the designer for the particular discipline (i.e. Grading, Drainage, or Structures).

Under the Document Control procedures, design changes can be transmitted to the field offices electronically. During interviews it was suggested that the system could be improved by assuring that design specification changes affecting the project in general were received by all the subconsultant design firms. Most of the changes have been in the roadwork portions of the project with approximately 25% of the changes resulting in post-design requests by the Contractor.

During the final contract negotiations, Wasatch Constructors proposed design changes which they felt were an improvement to the original plans. Many of these changes were included in the contract signed for the construction. In the ensuing year after construction began a number of change order requests were made. Because the process of processing change orders was cumbersome and bogged down in the approval process the parties to the contract met to resolve the backlog. A Memorandum of Understanding (MOU) was developed allowing Wasatch to change elements of the project if the changes were adequately supported, resulted in "equal to or better" changes and were followed by a "Technical Agreement" executed with no additional monetary consideration to the Contractor. The MOU also reallocated some of the risks associated with the changes.

Design changes are issued by 'Design Directives' approved by the Design Manager. Changes may be the result of internal or external review comments and the resolution of technical issues that surface during the design and construction process. In all cases, changes are directed formally or through the documented actions of the task forces, as prescribed by the Quality Management Plan and QC/QA Plan.

Changes to drawings or specifications already issued for construction are noted as revisions on the drawing/specification being altered with changes highlighted in bold text, circled, clouded, or emphasized

by some other method, thereby ensuring incorporation of changes in the construction. Any changes to the I-15 Corridor Standard Specifications, however, require a change order approved by UDOT. It should be noted that the changes to the Corridor Standard Specifications have not been consistently transmitted to all the subconsultant design firms in a timely manner.

Sverdrup/DeLeuw quality verification policies require that changes to a design be made and approved by the original designer. This referral to the original 'Designer of Record' is common in most agency QC/QA procedures, whether the design was accomplished by staff engineers or consultant engineers. The Sverdrup/DeLeuw team's procedures for the production of design drawings are also the basis by which the Design Manager controls the production and changing of design drawings. All 'major' field design changes (those that need referral back to the original designer) are processed through Sverdrup/DeLeuw and are subject to the approved QC/QA process.

Design changes required during construction and all communication between Wasatch Constructors and UDOT are directed through the Construction Segment QA Manager on individual segments and through the Wasatch QC/QA department on project wide issues. For safety related issues, any UDOT representative can communicate directly with the Wasatch Team Supervisor in charge with follow-up through the overall I-15 Q/A Manager.

Changes encountered at the field level are documented by Segment QA personnel, with the Segment Design Coordinator providing a scope of the change proposing an alternative solution to the Construction Segment QA Manager. This is documented on the Field Design Change Form, included in (DQP) 3.12. The Construction Segment QA Manager determines whether the change is 'minor' or 'major' and if the change constitutes the need for Target Design Services or Post Design Services.

Minor changes are approved by the Construction Segment QA Manager and returned to the Field Design Coordinator. The changes are then routed back through the Construction Segment QA Manager to release for construction and distributed to UDOT. The changes are reflected on the 'as-built' plans by the Field Design Coordinator.

The segment design coordinator brings major changes to the attention of the Construction Segment QA Manager who contacts the Post Design Technical Liaison at the 'HUB' Office, specifies the timeframe in which a response is needed and oversees the investigation of a solution. The Post Design Technical Liaison ensures that the solution undergoes design QC/QA, a constructability review, environmental review and release for construction through the Construction QA Manager.

Major changes requiring the Project Designer's input prior to commencing work are defined as follows:

- Revision in scope of the contract and of any standard design feature or specific element to the mainline, ramps, frontage roads, crossroads, significant detours, structural section and access control.
- Modification of major structures.
- Addition, deletion, or modification to the work stipulated by written agreement between UDOT/Wasatch and a private party, corporation, utility, or other governmental unit. Or, generating new work under the contract that requires written agreement.

- Changes to the character of work or site condition.
- Any changes in the specifications, method of material processing, type or quality of materials to be furnished (with exception of minor building materials), or “proprietary” materials for which specific or blanket approval has not been previously documented.

All non-contractor initiated changes, regardless of origin, are initiated through UDOT and directed to Wasatch with a request for price quotation. Consultation with Wasatch within seven days is then required.

Field Changes are accomplished by a Field Design Memo having a separate release process to approve the changes as quickly as possible. The response to a Field Design Memo is a plan change issued through the QC release process or a memo stating that the proposed change is approved. This process was revised from the original QC/QA process after the project was underway.

Over 1,000 construction memos have been issued; 900 for information only. Of the 100 that required design review, 30 involved non-compliance, meaning that work was subject to removal. Wasatch has its own process for rejecting work and the UDOT staff has not had to order removal of any work thus far. However, there are concerns by UDOT staff that the Contractor has the prerogative to attempt to remedy work that might normally be considered in non-compliance by traditional methods and removed.

CONCLUSIONS

At this stage of the design process, a number of observations have been made of things that have worked well and areas where improvement could be made. Below is a listing of several of these issues:

1. Partnering is absolutely necessary for a successful design-build project. Three teams composed of Wasatch Constructors, UDOT, and Sverdrup/DeLeuw were established to effectively deal with issues using partnering methods.
2. On any large design-build project it is imperative to locate all partners in one facility for effective coordination. This should include sub-consultant design teams although this did not happen in all cases on this project.
3. Flexibility on the part of the owner to authorize the Field Staff to make decisions is a key to this type of project. UDOT however, did not delegate this authority to its Resident Engineers, possibly because some do not have the experience to readily deal with field changes.
4. “Over-the-shoulder” reviews are necessary to keep the project on schedule. Overall, the level of oversight and emphasis placed on QC/QA procedures and processes is impressive with all three parties (Wasatch Constructors, DeLeuw/Sverdrup and UDOT) continuously stressing the importance of the QC/QA program.
5. Task Force meetings held on a regular basis are essential. The meetings should be structured and emphasize resolution of issues.
6. It is important to define and understand the differences between performance specification and prescriptive specifications. Some felt UDOT used too many of its Standard Specifications. Standard contract administration sections contained in UDOT’s Standard Specification should be eliminated.

since they do not apply to this type contract. Replacement provisions tailored to Design/Build contract language should be substituted.

7. Where possible, it would have been more helpful if UDOT had developed a set of standard details to be used on the design.
8. While the pre-design work provided by UDOT allowed Wasatch Constructors to begin construction earlier, this work created unforeseen problems. UDOT has stated that they would not include complete design packages on future projects.
9. There is a definite advantage in having the geotechnical work essentially completed up-front. This has proved to save money and resulted in getting the project off to a faster construction start.
10. Cross drainage design should have been completed up front because it affects the grading and drainage details.
11. While it took some time to implement the QC/QA audit plan now works well. The roles of various checkers need to be clearly defined.
12. QC on the construction side of the project needs better definition. This is a relatively new concept and most agency staff is not used to QC being performed by the Contractor.
13. A comprehensive document control system is absolutely essential to prevent premature release of design documents.
14. A comprehensive document tracking system is also essential and the system used on this project appears to function well. For example, Field Design Memorandums are tracked in the same manner as Office Design Memorandums.
15. The "Technical Agreement" process developed by Wasatch and UDOT can be included in future projects. It can encourage willingness on both sides to partner and make reasonable changes in a timely manner.
16. A sufficient number of design personnel must be retained for effective post-design support. The design consultant plans to keep 10 to 20 personnel on-site for this purpose.
17. A positive feature is that Design-Build requires fewer design sheets and few quantity tabulations. Most of the other details are similar to a design-bid-build project.
18. Design teams are not on a "fixed fee" basis. Wasatch has made provisions to compensate designers if there are unforeseen design problem to be resolved. Wasatch Constructors has also worked with this same design team on other projects and learned that this is a necessary arrangement.
19. The MSE wall performance specifications have resulted in some difficulty administering acceptable tolerances. This needs to be addressed in more detail.
20. A project this large creates long period of high stress making it difficult to remain on schedule.

3 CHAPTER QC/QA PROGRAM

INTRODUCTION

The purpose of this evaluation is to compare the QC/QA process being utilized on the I-15 Design/Build (D/B) Project with the normal QC/QA process that is in place on other state highway projects throughout Utah.

The sources of data and opinion included in this report come from interviews conducted with QC/QA staff and management within Wasatch Constructor and UDOT organizations and available documents including The Quality Management Plan, Volumes I & II; The I-15 Corridor Reconstruction Project Design/Build Contracting Initial Report; The Utah Department of Transportation Construction Manual, and various quality reports generated by ATSER, Wasatch Constructors and UDOT.

THE □NORMAL□ PROCESS

Normal QC/QA processes are defined as those outlined in the current edition of the Utah Department of Transportation Construction Manual. According to the manual administration of activities performed by private contractors is the responsibility of the Division of Construction. UDOT Region Two and the Regional Director, reporting to the Deputy Director of the Department would normally be assigned the overall task of administration of a traditional project similar to the I-15 D/B Project.

Working under the direction of the Regional Director would be a Region Construction Engineer, who under the normal process would assign a Resident/Project Engineer to directly administer the I-15 D/B Project. Given the size of this project, it is likely that the Resident/Project Engineer would supervise four Deputy Resident/Project Engineers, one who would administer each of the three segments of the project and the Automated Traffic Management System. The Resident/Project Engineer would be the Department's representative on the Project.

According to the UDOT Construction Manual, among the Resident/Project Engineer's duties would be the responsibility to ensure that □contract work is performed in accordance with the contract provisions, and that all materials incorporated in the work have been tested and accepted by the proper authority “. To facilitate the proper execution of these duties, the Resident/Project Engineer is assigned a project field crew whose duties are summarized as follows:

- Directly responsible to the Resident/Project Engineer or their assigned alternate
- Plans and directs the daily work activities for the construction survey party
- Supervises and inspects operations, phases or stages of construction and material production operations and documents same
- Performs calculations in laying out various project elements and the measurement of quantities
- Inspects and samples materials, performs tests on samples and documents same
- Performs other tasks and documents activities as directed by the Resident/Project Engineer
- Assists in determining and ensuring compliance with the contract requirements

The Central Lab provides correlation testing and other testing as required by the Resident/Project Engineer.

Based upon the number of Wasatch Constructor staff currently assigned to the project and interview comments by various engineers at the site, it is estimated that the UDOT staff would number between 150 and 200 individuals to administer the normal process.

In general, under UDOT's "normal" process, it is the Resident/Project Engineer's responsibility to inspect, test and document the work of the contractor in order to ensure that the completed project meets the minimum department standards for quality. Quality control efforts would be primarily for production calibration and fine-tuning. Quality assurance testing would provide the basis for project acceptance.

THE I-15 D/B PROCESS

There are many factors in the D/B process that require a unique approach to QC/QA. One of the most significant is the addition of design and maintenance to the construction contract. Design is typically completed, reviewed and approved by UDOT prior to the start of construction of a project whereas it was included in the I-15 Design/Build contract. Maintenance, typically the responsibility of UDOT after project acceptance, may be included in Wasatch Constructor's contract, at UDOT's option. Wasatch Constructors was required to develop a Quality Management Plan that addressed design, construction and maintenance of the I-15 D/B Project.

Due to the extensive nature of the I-15 Corridor Reconstruction Project, the Quality Management Plan and QC/QA Plan are documented in a series of progressively detailed quality manuals. Together, these documents define the project's quality system. These manuals include:

- Quality Management Plan
- Quality Control/Quality Assurance Plan, Part One: Quality System Standards
- Quality Control/Quality Assurance Plan Part Two and Three:
 - Design, Construction and Maintenance & Materials and Equipment
 - **Volume I**, Design Quality Management Plan (DQMP)
 - **Volume II**, Construction Quality Management Plan (CQMP)
 - **Volume III**, Maintenance Quality Management Plan (MPMP) during Construction

DESIGN QC/QA, -WASATCH

The Design Quality Management Plan (DQMP) is designated Volume One of the Quality Management Plan (QMP). It was prepared by Wasatch Constructors and their subcontractor Sverdrup/De Leuw, a joint venture of Sverdrup Civil and De Leuw Cather. Implementation of this DQMP is the responsibility of the Sverdrup/De Leuw Quality Organization.

At the top of Wasatch Constructor's organization chart is the Principal On-Site who plans, administers and authorizes the use of all Wasatch resources assigned to the Project. This person is directly responsible for the completion of all contract requirements and regularly reports to the joint venture control boards which include representatives from both Wasatch Constructors and Sverdrup/De Leuw,

and the UDOT I-15 Management Team. Figure 3-1 shows the organization used by Wasatch Constructors.

Reporting directly to the Principal On-Site is the Project Manager, who is responsible for all design, construction, maintenance and quality control on the Project. Also reporting to the Principal On-Site is the Quality Assurance Manager. Figure 3-2 presents a more detailed organization chart of Wasatch Constructors.

The Quality Assurance Manager is a Wasatch Constructors employee who utilizes Sverdrup/De Leuw staff to perform Quality Assurance on design, construction and maintenance. All positions in the organization chart above the Quality Assurance Manager are held by Wasatch Constructors staff.

Reporting directly to the Quality Assurance Manager is the Design Quality Assurance Manager (DQAM). The DQAM audits every sheet of design work produced by the Wasatch design group. Primarily checking to see that the QC process has been adhered to, spot checks of actual calculations and other design criteria are performed. To date more than 5,000 audits have been performed. No design drawings go to the field without the DQAM's review and approval. Specific duties of the DQAM include:

- Establishing and implementing the I-15 Corridor Reconstruction QC/QA Program and Plan
- Overall coordination and direction of the Design QC/QA program
- Preparing, coordinating, distributing and maintaining QA policies, procedures, standards and guidelines
- Audits of design QC/QA activities
- Certification of all design documents prior to submittal to the Contractor
- Providing training to project personnel on QC/QA requirements
- Establishing, implementing and maintaining the ISO Q 9001 procedures for certification and registration for the life of the Project

Quality Control of design is completed within the production process. The Construction Design Manager is a Wasatch Constructors employee who serves as the point of contact with the Sverdrup/De Leuw joint venture. This person manages constructability reviews at various levels of the design process. Reporting to both the Construction Design Manager and the Sverdrup/De Leuw Joint Venture control board is the Design Manager, who manages the Sverdrup/De Leuw design effort. This is a Sverdrup/De Leuw employee and the point of contact for the Wasatch Constructors. Among his/hers numerous duties is the budgeting of the QC/QA effort for design work.

QC is an element in the responsibilities of all subordinate staff. The key position for QC in this group is the Section Design Manager, who also serves as the QC Document Coordinator. As Coordinator, duties include:

- Is fully knowledgeable of the Design QC/QA procedures
- Responsible for the completion of all QC functions within the section
- Performs day-to-day surveillance of project activities
- Provides orientation to design team personnel regarding QC/QA requirements
- Maintains current listing of audit dates, results, and the status of documents under review

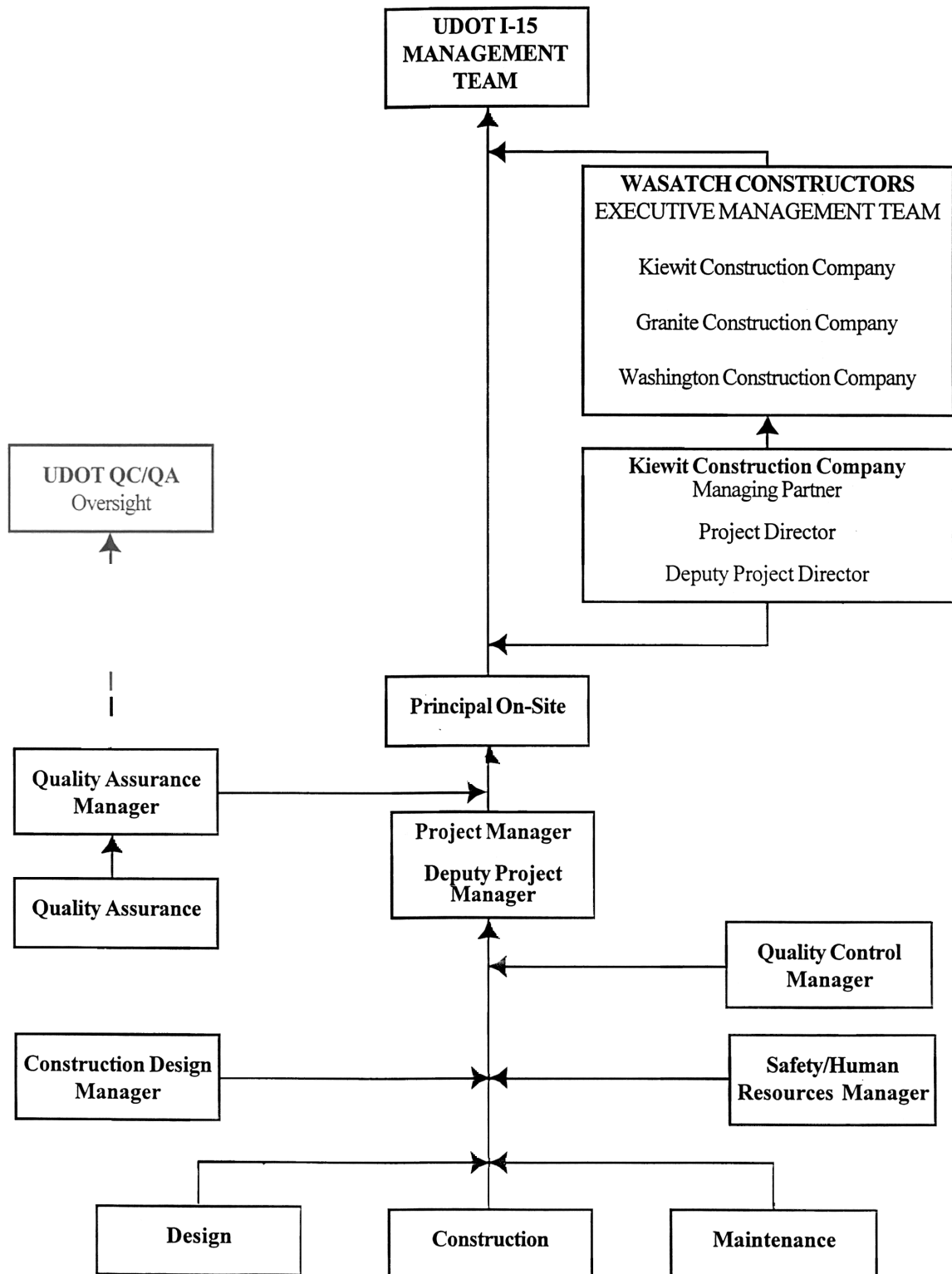


Figure 3-1

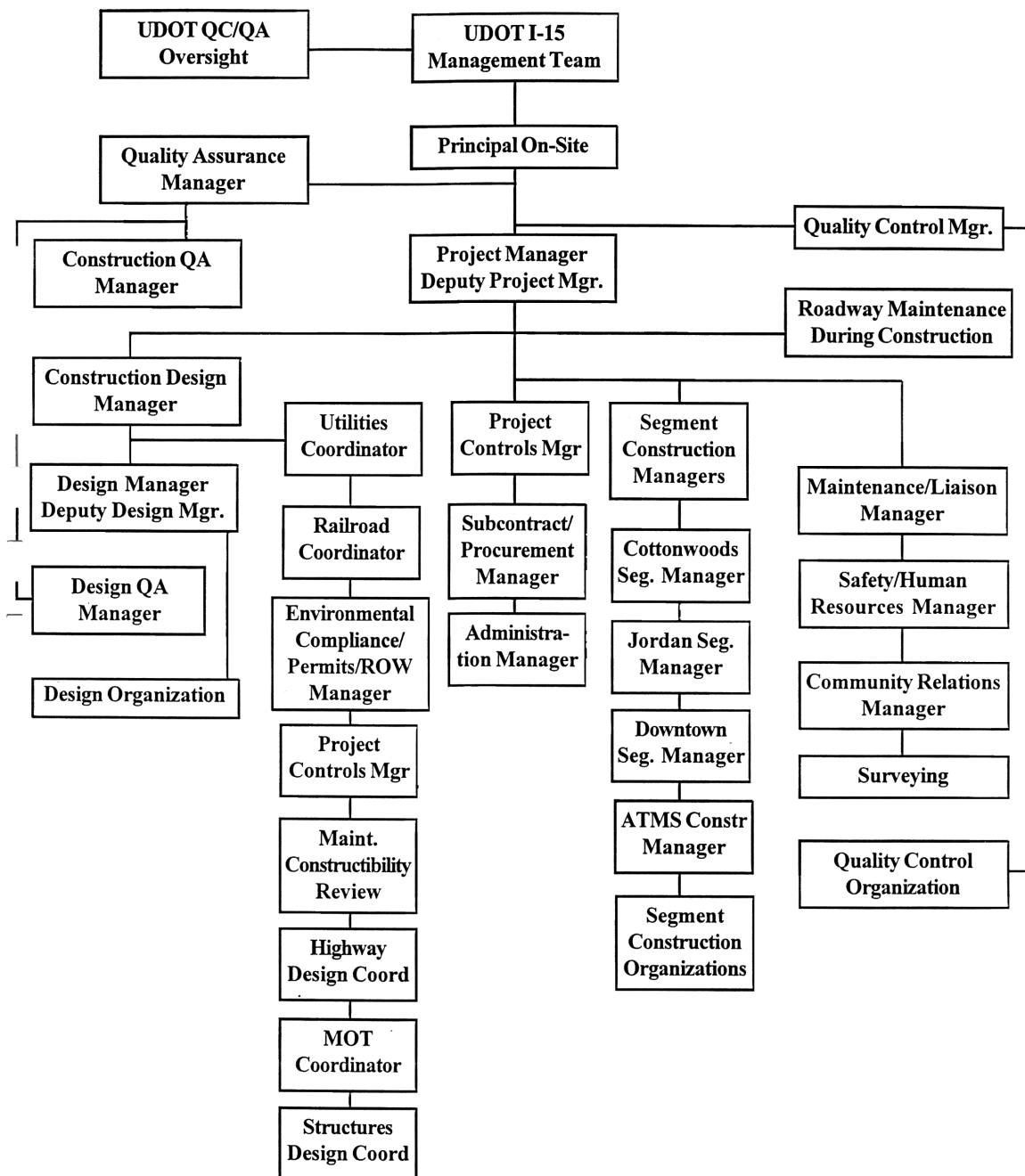


Figure 3-2

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- Provides status reports to the DQAM as required
- Controls all plan sets and QC documents until delivered to final document control

A standard design QC procedure is utilized which involves checking, back checking and verification of design drawings and documents. A formal procedure which includes forms and colored highlighting has been developed and is uniformly utilized by Sverdrup/De Leuw staff and their subconsultants.

Key definitions in the DQMP include:

- Quality Assurance:*** A program of planned policies, procedures, detailed responsibilities and systematic actions necessary to provide adequate confidence that a structure, facility, system or component will perform satisfactorily in service.
- Quality Control:*** The acts of examining, witnessing, inspection, checking and testing of in-process or completed design work, including in progress plan sheets, studies and reports to determine conformity with contract requirements.

The Quality Management Plan, including the DQMP, has been certified ISO 9001. This enhances the consistency of the Plan.

DESIGN QC/QA-UDOT

The I-15 D/B Project is managed by the UDOT I-15 Management Team, which reports directly to the Utah Department of Transportation Director. The Management Team is composed of a Project Director, who works directly with the Public Information Group and the Deputy Project Director. The Deputy Project Director manages Contract Administration, Construction Oversight, Railroad, Right-of-Way & Utilities, Quality Oversight, and Technical Support. This organization is shown on Figure 3-3.

Three groups to be discussed in this evaluation include Technical Support, Construction Oversight and Quality Oversight. These organizations are shown on Figures 3-4, 3-5 and 3-6.

Technical Support is headed by the Technical Support Manager, who is responsible for Design Quality Oversight, Environmental Oversight and Engineering Support. Engineering Support is broken into Roadway, Structural, and Geotechnical Oversight.

The Technical Support Group provides UDOT oversight of the Wasatch Constructors Design QC/QA process. This is done through "over the shoulder" reviews performed by the Roadway, Structural and Geotechnical Oversight Engineers at 30, 60 and 90 percent submittals, and by end product reviews, performed by the Design Quality Oversight Engineer.

Over the shoulder reviews are done with the Wasatch Constructors designers as an "in process" activity, with very little disruption to the design sequence. This is done in conjunction with weekly task force meetings, where design concepts to be used in the I-15 design are discussed. This group also regularly reviews the QA process documentation to ensure compliance with that process.

Oversight Engineers also review Field Design Modifications (FDM) for compliance with design objectives. This is done through multiple weekly meetings with the Wasatch group. The UDOT Segment Staff also attends meetings regarding FDM issues when they are of interest to the individual Segment

I-15 Reconstruction **UDOT Project Organization**

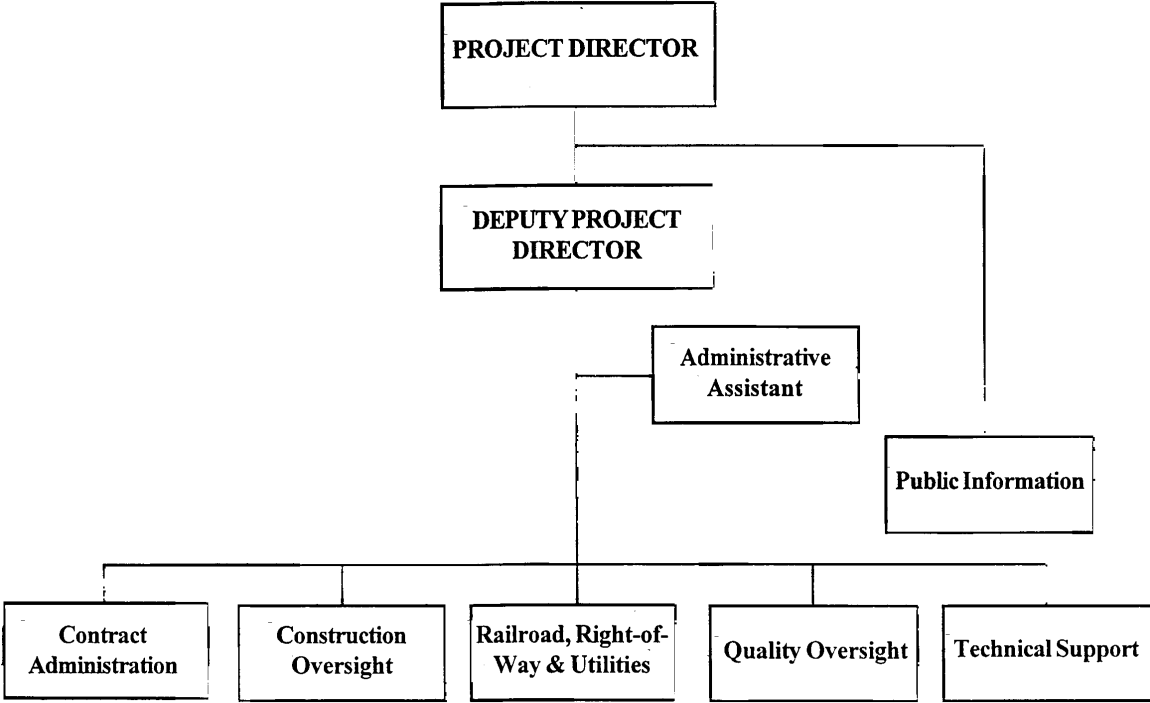


Figure 3-3

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UDOT Technical Support

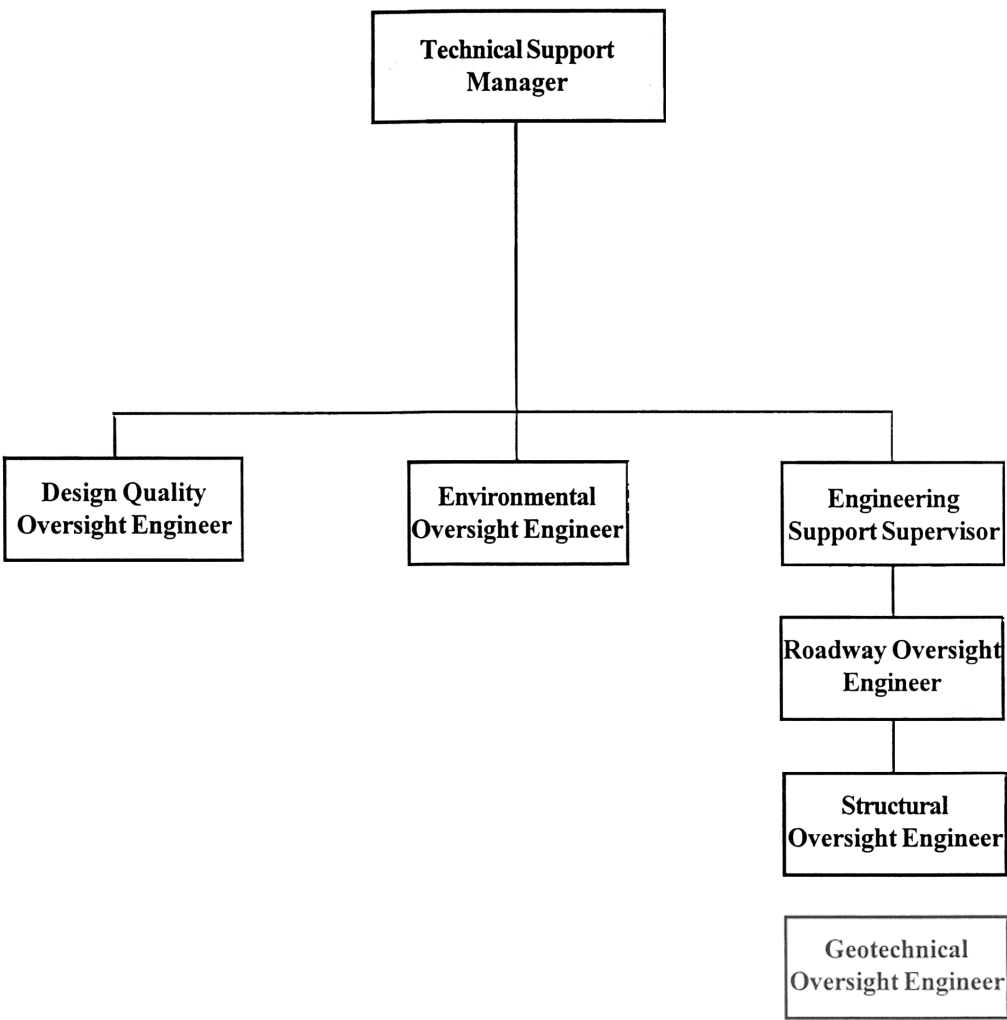


Figure 3-4

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UDOT Construction Oversight

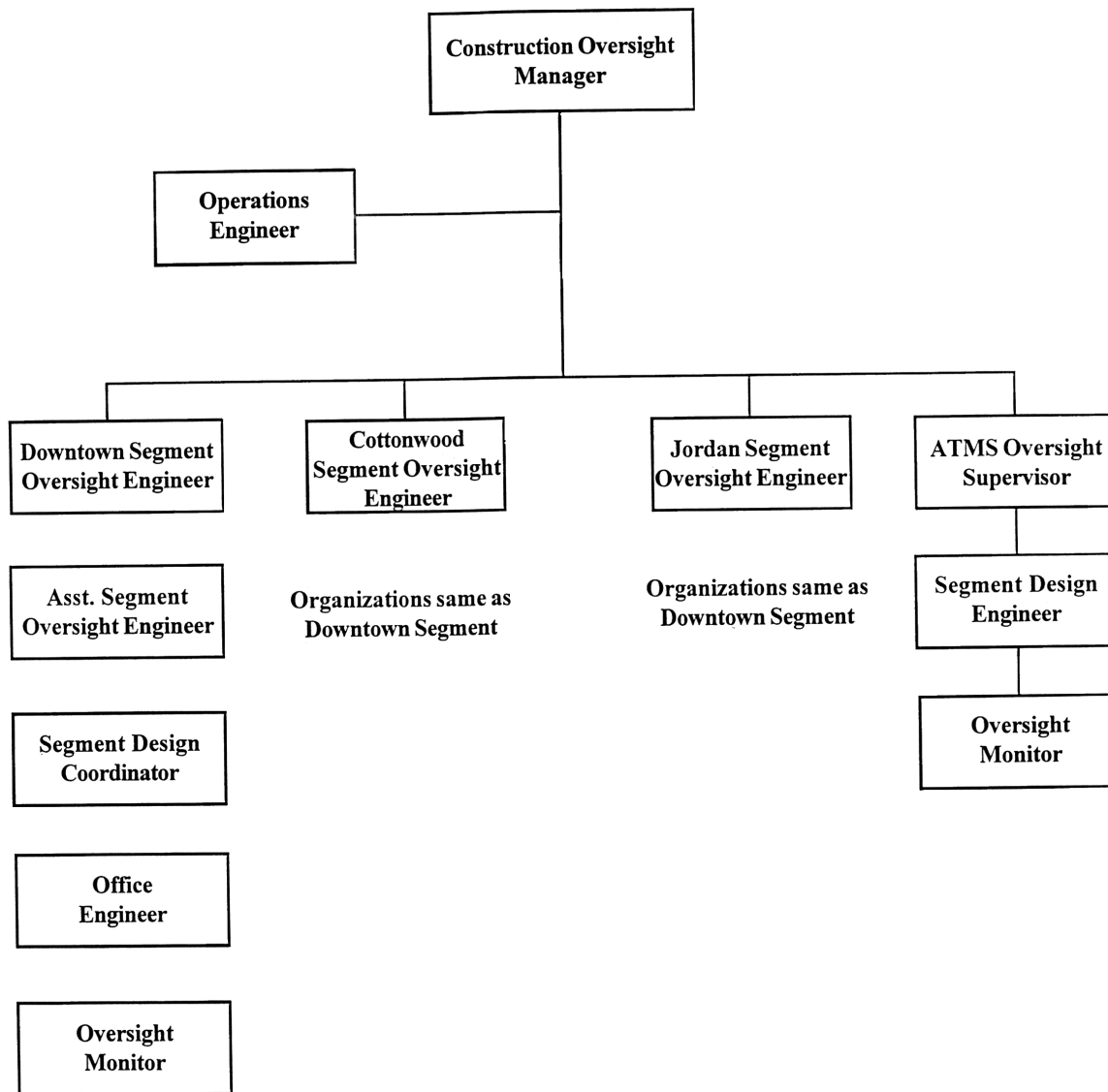


Figure 3-5

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UDOT Quality Oversight

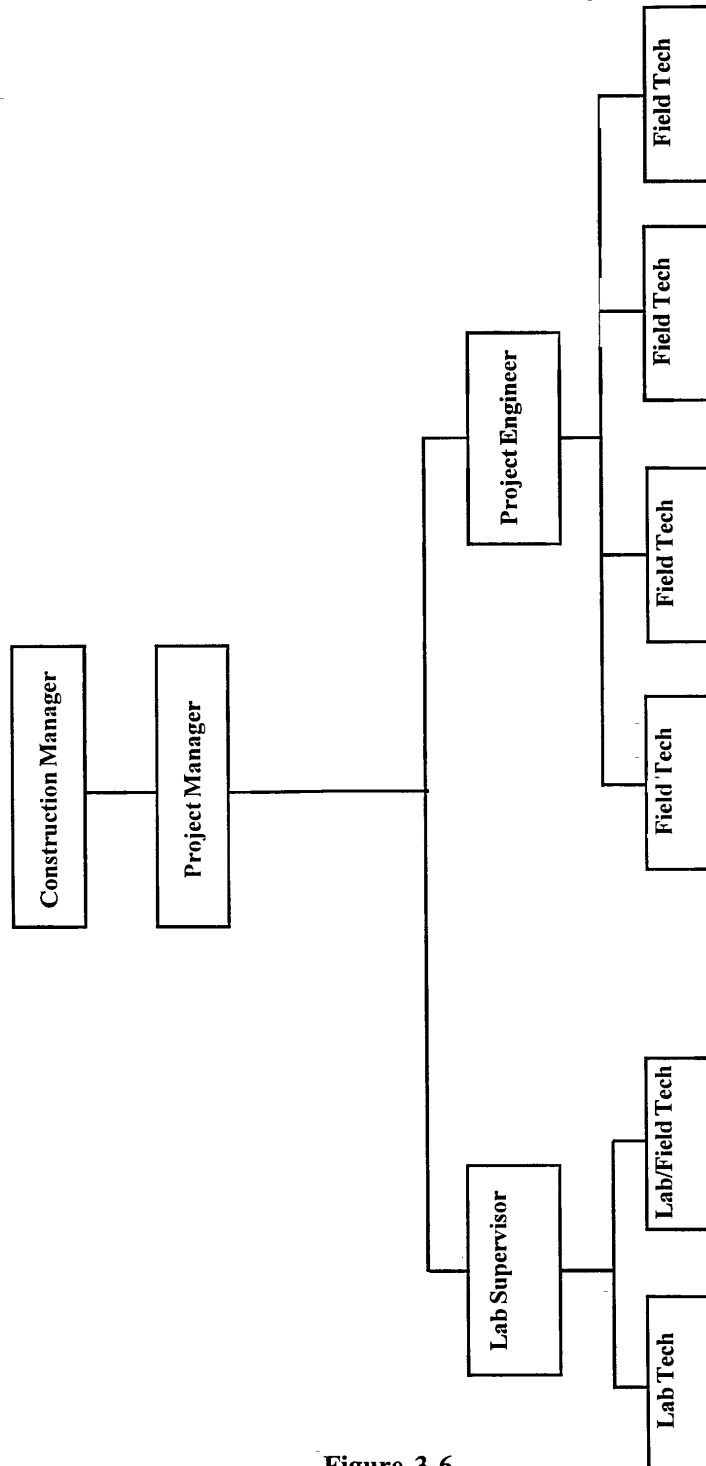


Figure 3-6

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Manager. A flow chart of the process followed in the FQM process is shown on Figures 3-7 and 3-8.

Finally, the Technical Support Group provides technical support to all UDOT field staff as the need arises.

CONSTRUCTION QC/QA,

Construction QC/QA on the I-15 D/B Project is best described as very "layered". The overall process includes QC/QA by Wasatch Constructors (provided primarily by Sverdrup/De Leuw staff) and oversight by UDOT (Region Two and the Central Lab) which includes testing, inspection and audits; and verification testing by ATSER, a private consulting firm employed by UDOT.

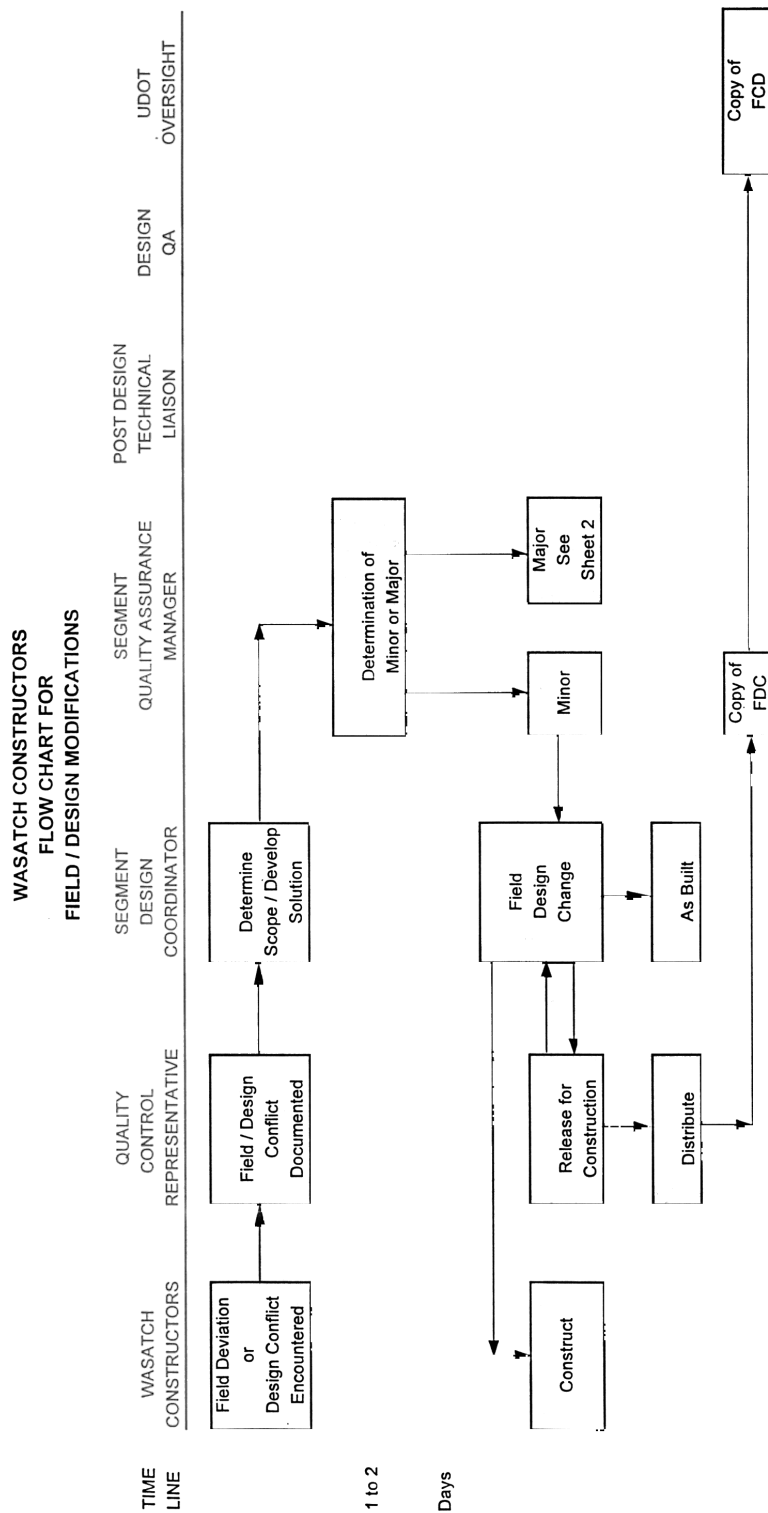
Construction QC/QA, -Wasatch

Volume Two of the Quality Management Plan addresses the Wasatch Constructors approach to QC/QA during construction. The Project QA Manager reports directly to the Principal On-Site, the most senior position within the project staff of Wasatch Constructors. The Project QC Manager reports directly to the Project Manager, the number two person in the Wasatch Organization, and is responsible for all QC efforts on the project. Both the QC and QA Managers have their own staff assigned to them, and operate independently. As stated earlier, the QA Manager's staff is composed of Sverdrup/De Leuw employees, but the QC Manager's staff consists of Wasatch Constructors employees. Wasatch managers define QC as end process control and acceptance testing, while QA is defined as surveillance and audit functions. Volume Two defines QC and QA in an identical manner to Volume One, listed previously in the design overview chapter.

The Project Quality Control Manager (PQCM) has no responsibility other than "quality" related aspects of the project, and the implementation of ISO 9003 standards. This manager has a staff of approximately 120 technicians and professionals. Specific functions of the PQCM include:

- Overall responsibility for the acceptance of the work
- Establishing and implementing a QC Program and Plan
- Overall coordination and direction of the QC program
- Preparing, coordinating, distributing and maintaining QC policies, procedures, standards and guidelines
- Providing support services to the I-15 Project QC organization to assure the quality of work essential to the QC goals of the project
- Maintenance and retention of qualification, orientation, training and certification records of QC staff
- Providing certification that all materials and labor on the project have been inspected by the QC group and that all work, except as specifically noted in the certification, conforms to the requirements of the contract

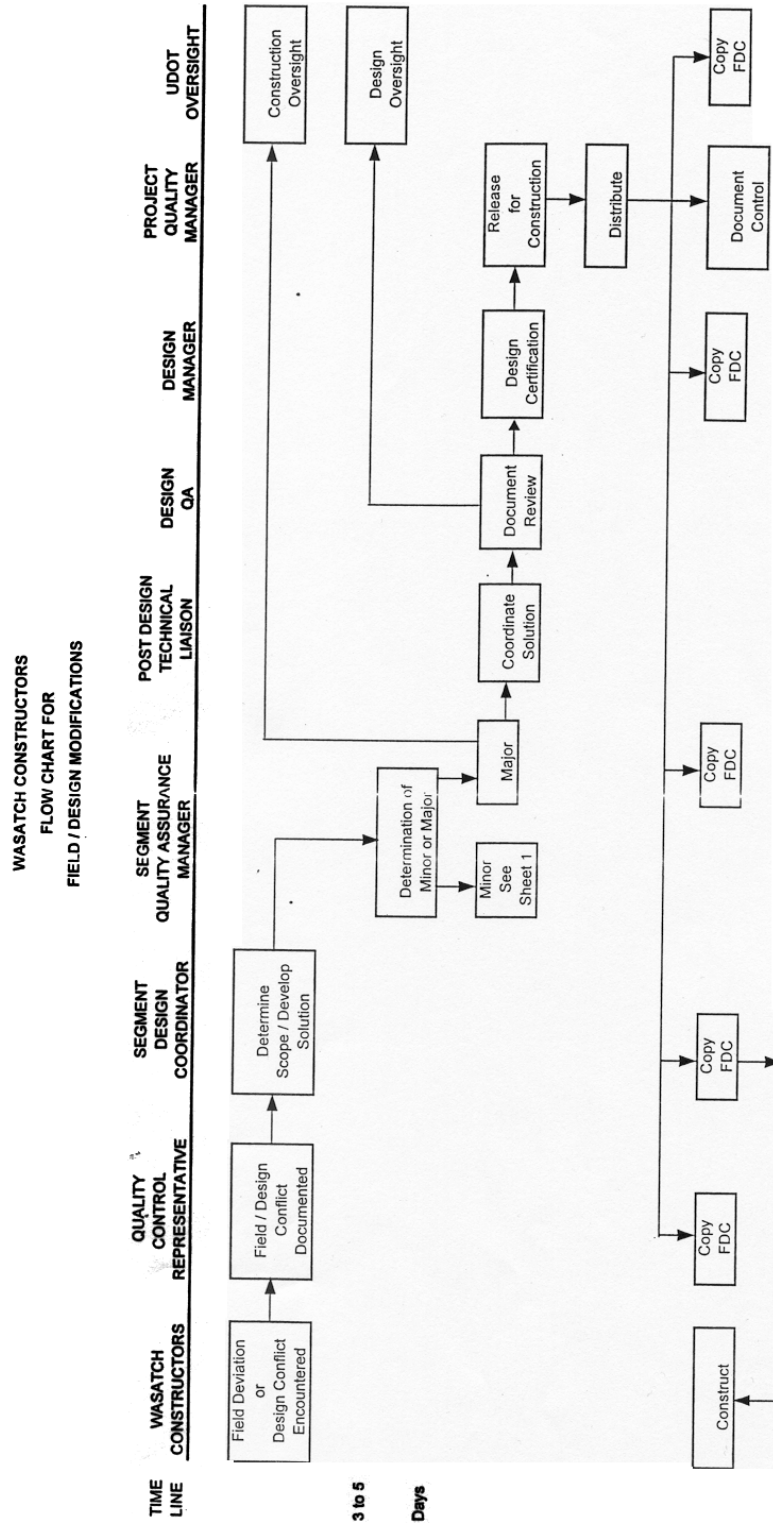
Reporting directly to the PQCM are four QC Managers, one for each of the three segments of the project, and one for the Automatic Traffic Management System (ATMS). Fifteen to twenty five technicians are assigned to each group. In addition, a number of off site inspectors are employed by Wasatch to monitor fabrication and production sites, some of which are located out of state. There is also a Project Laboratory that employs approximately ten testing technicians and also service agreements with outside



Responsibility of Entities

WASATCH Constructors - Construct from approved and Released for Construction plans and documents including designer clarifications and verification.
 Field Design Coordinator - Interface with Segment QC Representative and Segment QA Manager to propose solutions to conflicts, acquire and document all changes. Provide As Builts.
 QC Field Representative - Inspect and approve Construction, documents field/design conflicts and resolution. Releases FDC for construction and distributes change documents.
 Segment Quality Assurance Manager - Determines "minor" versus "major" changes; authorize FDC for "minor" change.
 Post Design Technical Liaison - Provide Solutions to Major Changes. May be in the form of answers to Request For Information or Revised Plans and Special Provisions.
 UDOT Oversight - Review Field Design Changes and Oversight of corrective action.

Figure 3-7
3-12



Responsibility of Entities

WASATCH Constructors - Construct from approved and Released for Construction plans and documents including designer clarifications and verification.
Field Design Coordinator - Interface with Segment QC Representative and Segment QA Manager to proposed solutions to conflicts, acquire and document all changes. Provide As Builts.
QC Field Representative - Inspect and approve Construction, documents field/design conflicts and resolution. Releases FDC for construction and distributes change documents.
Segment Quality Assurance Manager - Determines "minor" versus "major" changes; authorize FDC for "minor" change.
Post Design Technical Liaison - Provide Solutions to Major Changes. May be in the form of answers to Request For Information or Revised Plans and Special Provisions.

Figure 3-8
3-13

testing laboratories for specialty testing. The Wasatch Constructor's Quality Control Organization is shown on Figure 3-9.

Testing frequencies in the field for QC are occurring at the minimum frequency requirements stated for normal QC in the UDOT Construction Manual. QC testing is the point of acceptance in the Wasatch QMP, with QA utilized for verification only.

Quality Assurance, the auditing and surveillance element of the Wasatch QC/QA effort, is administered by the Project QA Manager (PQAM). Reporting directly to the PQAM is the Construction Quality Assurance Manager (CQAM). The CQAM supervises the Assurance Inspection and Quality Assurance, (QA) Testing and is responsible for insuring that the program of testing and inspection is adequate to validate Contractor Acceptance Testing (CAT). The CQAM also serves as the Maintenance QA Manager (MQAM). The CQAM's duties include:

- Establishing and implementing a Construction QA Program and plan
- Preparing, coordinating, distributing and maintaining QA policies, procedures and guidelines
- Developing QA inspection and test procedures, in cooperation with UDOT and the Quality Control Department, for use on the I-15 project
- Assuring that QA personnel requiring certification are properly certified and maintaining a file of pertinent information concerning certifications
- Providing a signed certification stating that the Construction Quality Management Plan and all of the measures and procedures provided therein are functioning properly and are being followed

Reporting directly to the CQAM are four Segment Construction Quality Assurance Managers (SCQAM) who are responsible for the three construction segments and the ATMS. Each SCQAM has an inspector, tester and auditor assigned to them except for the ATMS SCQAM, who has only an auditor. In addition there is an independent testing lab associated with the QA process, which has a staff of two. Wasatch Constructor's Quality Assurance Organization is shown on Figure 3-10

Quality assurance is provided by audit of documents, inspection and testing, and by the statistical analysis of the resulting data as well as data provided by the QC group.

Document tracking is facilitated with the use of Expedition, a proprietary tracking software, which is linked to Primavera P3, a proprietary scheduling software. All documents are linked to one of the approximately 6500 activity codes in the scheduling program and to the appropriate inspector or tester.

Monthly QA audit reports produced by the Quality Assurance Group document the qualifications of QC inspectors and the adequacy of the QC staff for the upcoming assignments. The reports also produce a statistical evaluation of QC testing that correlates the QC test results to QA test results. Finally, the reports certify that all construction work performed during the preceding month is in conformance with the contract documents. Work not in conformance is tracked through a Nonconformance Report (NCR).

Construction Oversight - UDOT

The Utah Department of Transportation is currently developing its own quality oversight procedures manual for the I-15 D/B Project. It should be completed prior to the next annual evaluation. Currently,

WASATCH CONSTRUCTORS **Quality Control Organization**

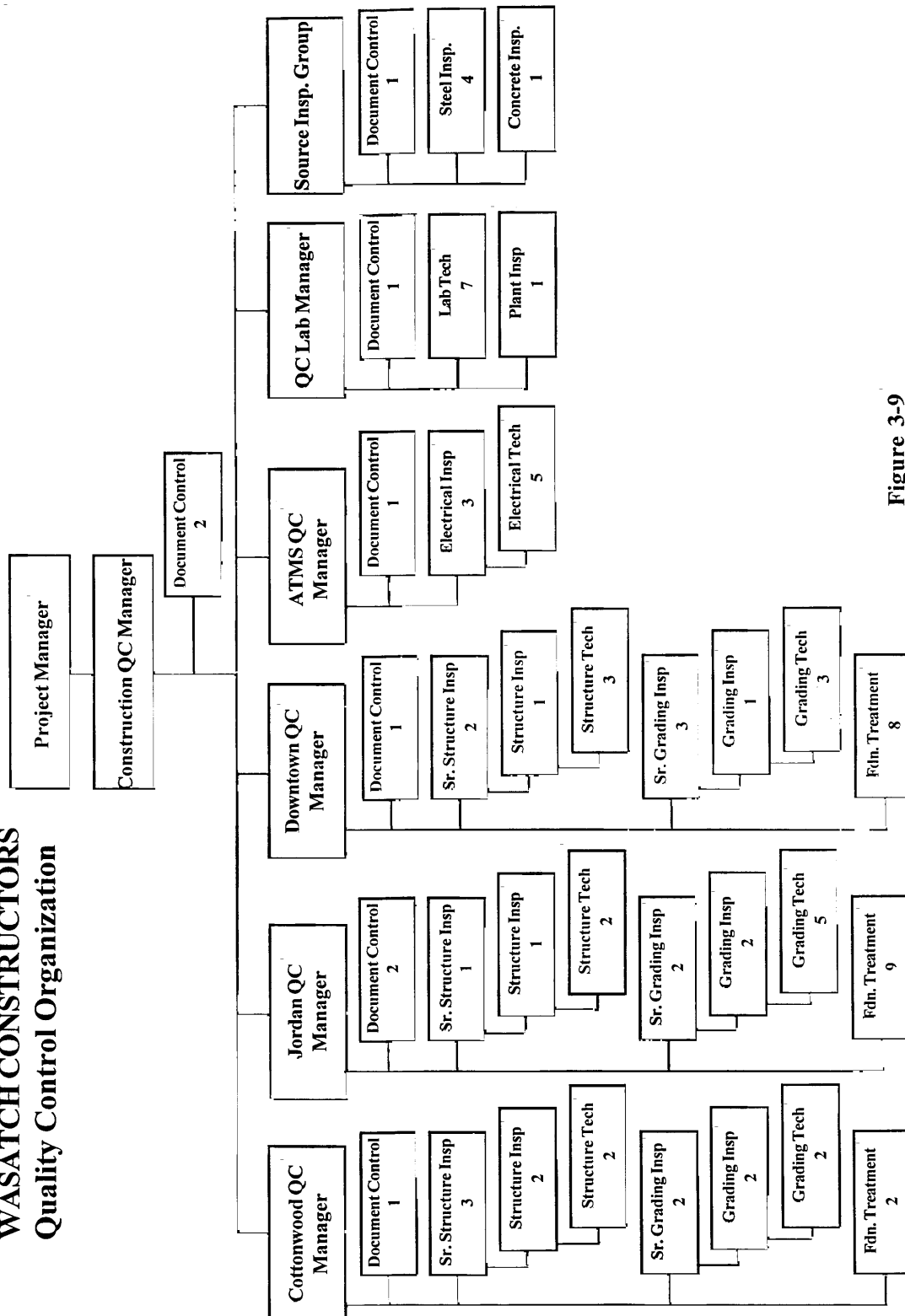
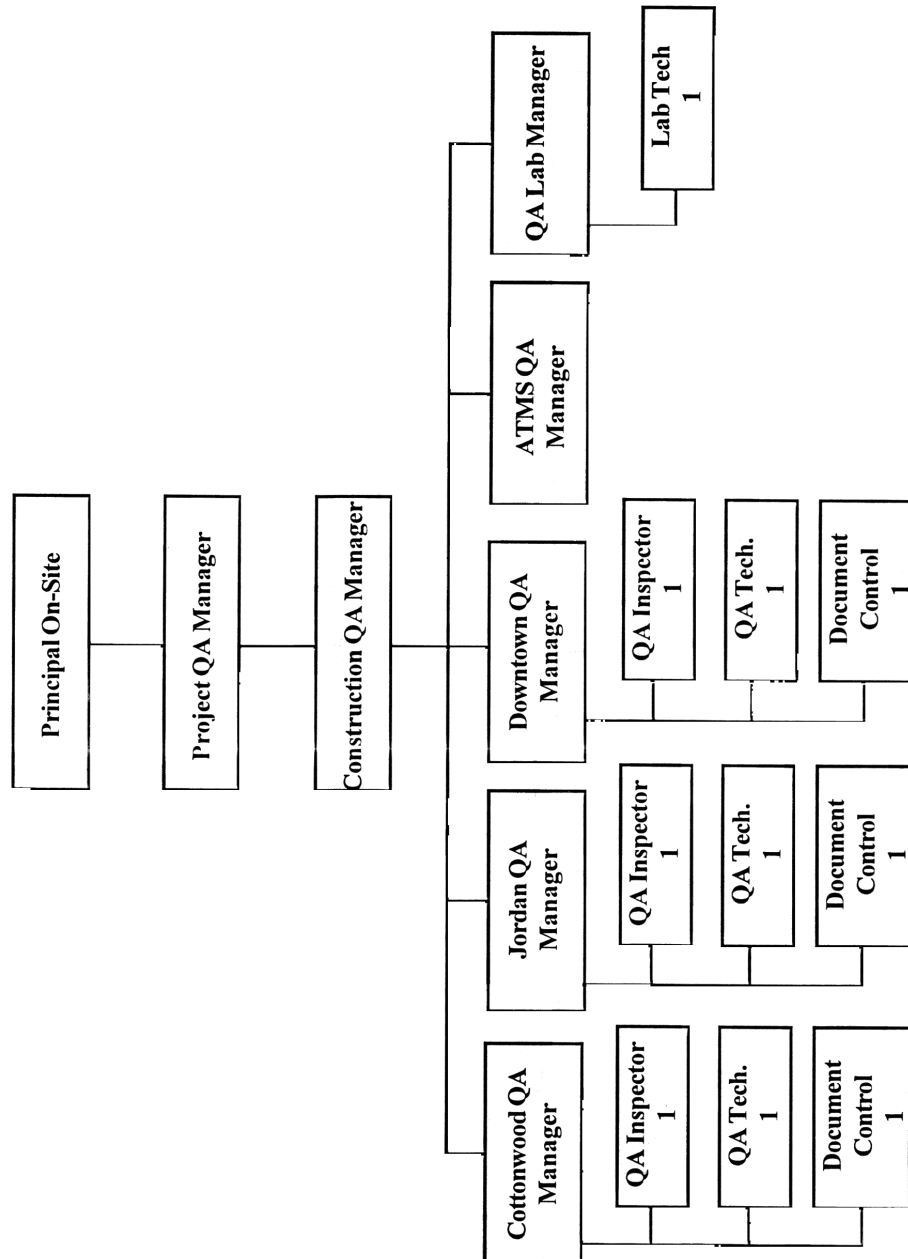


Figure 3-9
3-15

WASATCH CONSTRUCTOR'S Quality Assurance Organization



Numbers Shown are Current Level of Staffing

Figure 3-10

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both the manual and actual field procedures are under development, dovetailing into the Wasatch Quality Management Plan. This work is being completed by the Quality Oversight Group of the I-15 D/B Team.

Senior management at UDOT provides substantial support to the I-15 Team. The UDOT Director, Engineer for Construction & Materials, I-15 Construction Oversight Manager and I-15 Project Director meet regularly to discuss issues.

The Construction Oversight Group within the I-15 Team is headed by the Construction Oversight Manager. This person is responsible for each of four subsections of the project, the Downtown, Cottonwood and Jordan Segments, and the Automated Traffic Management System (ATMS). (See Figure 3-5)

Each of the Segments is headed by an Oversight Engineer, comparable in background and training to a UDOT Resident Engineer. The Oversight Engineer communicates with the Segment QC Manager for the Wasatch Team, and has a staff of four including an Assistant Segment Oversight Engineer, a Segment Design Coordinator, Office Engineer and Oversight Monitor. These are the I-15 D/B Team field representatives that provide UDOT with the "hands-on" observations utilized as a check on the Design/Builder's own QC/QA effort. While the Monitor reviews field practices of the Wasatch QC/QA staff, the Design Coordinator reviews "field changes" or field design memos (FDM) for compliance with D/B standards.

This group is supplemented by UDOT Region Two and Central Lab staff that provide independent assurance inspection and testing. Primarily focused on soils, asphalts and portland cement concrete, the group also checks precast and reinforced products. In addition they are used to ensure that other testing labs, testing staff and testing equipment meet the required standards. This includes the labs utilized by Wasatch Constructors as well as ATSER.

Construction QA - ATSER

ATSER, a private engineering consulting firm, was hired by UDOT to assist them in verifying the owner's independent assurance testing and is administered by the UDOT I-15 Construction Oversight Manager. Their verification and testing is both self directed and directed by UDOT staff. They are responsible for verifying that the sampling and testing compiled by the Contractor and UDOT is accurate and sufficient.

The ATSER team is headed by a Project Manager that is responsible for laboratory testing. Lab work is performed under the direction of a Lab Supervisor who has two technicians. A Project Engineer manages the verification work, with four field technicians reporting.

ATSER provides monthly reports to UDOT, which statistically compares UDOT's inspection and testing results to those of Wasatch Constructors. In providing these services ATSER verifies this element of the overall QC/QA plan of the I-15 D/B Project. Their role is intended to meet the Federal requirement that to use a Contractor's QC/QA data for acceptance decisions, it must be verified by the State Highway Agency.

ISSUES TO BE EVALUATED IN SUBSEQUENT REVIEWS

The following issues were noted in interviews with several individuals, and will be developed further in subsequent annual reports:

- ***The availability of qualified and certified testing and inspection technicians in the Salt Lake City area.*** The I-15 D/B Project provides an additional 140 (approximately) such positions to the local work force. The Wasatch Constructors Team has provided extensive training and certification opportunities for local individuals. It is generally agreed that at the conclusion of this project a very large, experienced and qualified group of technicians will have been developed.
- ***The duplication of effort in the current QC/QA process.*** Especially in the QA area, it is perceived that both UDOT and the Wasatch Constructors are performing similar tasks. ATSER provides verification checking.
- ***Responsiveness to contractor needs.*** The contractor provided QC seems to be able to respond well to the contractor's construction schedule. It also responds well to seven day per week, 24 hour per day, on call status, when required.
- ***Reduced UDOT project staffing levels.*** This system of QC/QA definitely reduces the need for UDOT staff on the project, based upon the level of effort provided by the D/B Team. On a project of this magnitude UDOT would have been challenged to provide adequate staff for the "normal" process.
- ***Loss of project control by UDOT.*** As is part of the process in D/B, the owner loses some control over the project processes, and relies more on end product results.
- ***Need for a documented UDOT D/B approach.*** As stated in previous text, a formal program is currently being drafted. The completion and acceptance of this documented approach will likely clarify many issues in the field.
- ***Perceived conflicts of interest.*** While a substantial effort has been made to isolate the QC/QA effort from production interests, the perception of a conflict of interest is difficult to eliminate. The results of the QC/QA effort may be most effective in eliminating or reinforcing that perception.
- ***Long term quality concerns.*** With reduced "hands on" inspection by the Owner, there is a much greater reliance upon reports and statistical analysis. The UDOT D/B contract has attempted to address this concern with optional maintenance service to be provided by the Design Builder.
- ***Acceptance of a "new" process.*** Both Wasatch Constructors and the Utah Department of Transportation have gone to great lengths to provide an I-15 staff willing to accept and support a process that, while not new to construction, only recently has been utilized on major transportation projects in the United States.

CONCLUSION

There are substantial differences in the "normal" QC/QA process and the I-15 process. It is easy to understand difficulties staff (both Wasatch and UDOT) may be experiencing in adapting to a new process regarding their assignments and the desired results of their efforts. This will likely be the greatest challenge for the successful inclusion of the design build strategy in the UDOT "tool box" for major public projects.

While the new process is a challenge, there are still many technical and procedural issues to be addressed as well. Information sharing and mutual trust need to be further developed, and both UDOT and Wasatch continue to work on these issues.

The I-15 Corridor Reconstruction Project is establishing new guidelines and procedures for D/B QC/QA that will be very valuable for use in future projects elsewhere. While the D/B process is somewhat project specific, there are many aspects of this project that will be applicable to other transportation projects throughout the United States.